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BY

WINIFRED GREGORY

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MINNEAPOLIS
1915

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L. S. M. I.	Lake Superior Mining Institute. Transactions	Ishpeming, Mich.
Met. and Chem. Eng.	Metallurgical and Chemical Engineering	New York.
Mex. Min. Jour.	Mexican Mining Journal	Mexico City.
M. and M.	Mines and Minerals	Scranton.
M. and S. P.	Mining and Scientific Press	San Francisco
Min. Mag.	Mining Magazine	London.
Min. Sci.	Mining Science	Denver.
Min. Wld.	Mining and Engineering World	Chicago.
M. G. S.	Minnesota Geological and Natural History Survey	Minneapolis.
Minn.Acad.Sci.Bull.	Minnesota Academy of Natural Sciences. Bulletin	Minneapolis.
Minn. Bur. Lab.	Minnesota Bureau of Labor	St. Paul.
Minn.Hist.Soc.Coll.	Minnesota Historical Society. Collections.	St. Paul.
Neues Jahrbuch	Neues Jahrbuch für Mineralogie, Geologie Paleontologie	Stuttgart.
Ottawa Nat.	Ottawa Naturalist	Ottawa.
Phil.Acad.Sci.Jour.	Philadelphia Academy of Natural Sciences. Journal	Philadelphia.
Phil.Eng.Club Proc.	Philadelphia Engineers' Club. Proceedings	Philadelphia.
Pop. Sci. Mon.	Popular Science Monthly	New York.
R. of Rs.	Review of Reviews	New York.
Royal Soc. of Canada.	Royal Society of Canada. Transactions	Montreal.
Sch. Mines Quar.	School of Mines Quarterly	New York.
Sci. Am.	Scientific American	New York.
Sci. Am. Supp.	Scientific American Supplement	New York.
Stahl und Eisen	Stahl und Eisen	Düsseldorf.
U. S. Bur. Mines.	U. S. Bureau of Mines	Washington.
U. S. G. S.	U. S. Geological Survey	Washington.
U. S. Nat. Mus. Proc.	U. S. National Museum. Proceedings	Washington.
U. of M. Eng. Soc.	University of Minnesota. Engineers' Society. Yearbook	Minneapolis.
Wash.Acad.Sci.Jour.	Washington Academy of Sciences. Journal	Washington.
Wash. Biol. Soc.	Washington Biological Society. Proceedings	Washington.
West. Soc. Eng.	Western Society of Engineers. Journal	Chicago.
Wis.Acad.Sci.Trans.	Wisconsin Academy of Sciences. Transactions	Madison.
Wis. Eng.	Wisconsin Engineer	Madison.
Zeit. für Prak. Geol.	Zeitschrift für Praktische Geologie	Berlin.
Zeit. Geol. Gesell.	Zeitschrift Deutsche Geologische Gesellschaft	Berlin.
Zeit. Gesell für Erdkunde	Zeitschrift Gesellschaft für Erdkunde zu Berlin	Berlin.

BIBLIOGRAPHY

A

1 **Abbott,** C. E. Iron ore deposits of the Ely trough, Vermilion Range, Minn. L. S. M. I. 12:116-42. maps. 1906. Abstract. E. and M. J. 83:601-05. Mr.30,1907.

History of exploration and discovery. Summary of general geology of the Range. General geology of Ely trough. Geology of individual deposits of the trough. Concentration of the iron ores. Topography. Underground waters.

2 **Abell,** O. J. Greatest year in the ore ranges' history. Ir. Trd. Rev. 42:95-99. Ja.2,1908.

Review of the activities of the year 1907, at the mines, on the railroads and the lakes. Gives notes on decreasing iron content, the taxation problem in Minnesota, and mine accidents.

3 ———— Much work done during a dull year. Ir. Trd. Rev. 44:17-23. illus. Ja.7,1909.

Summary of work during 1908, with special mention of the extensive stripping on the Mesabi and the sinking of several concrete shafts on the Cuyuna.

4 **Adams,** F. S. Iron formation of the Cuyuna Range. Econ. Geol. 5:729-40; 6:60-70, 156-80. illus. diagrs. D.1910-Mr.1911.

Discussion of the iron formation, chemical and mineralogical composition of the ores, and the deformation of the Upper Huronian series.

5 **Adgate,** F. W. Sinking through bad ground. M. and S. P. 95:183-86. diagrs. Ag.10,1907.

The pneumatic process was successfully used under unusually difficult circumstances.

6 **Agassiz,** Louis. Lake Superior; its physical characters, vegetation, and animals compared with those of other and similar regions. Boston, 1850. 428p.

Extract. The erratic phenomena about Lake Superior. Am. Jour. Sci. 2d ser. 10:83-101. 1850.

7 ———— Terraces and ancient river bars, drift, bowlders, and polished surfaces of Lake Superior. Am. Assoc. Adv. Sci. 1:68-70. 1849.

8 **Allen,** C. J. Annual report upon the preservation of the Falls of St. Anthony, and improvement of the Mississippi and tributaries above the Falls; improvement of the Red River of the North; reservoirs at the sources of the Mississippi River. U. S. Chief of Engineers Report for 1881. Appendix W. pp. 1739-1837. map. 1882.

Gives surveys of the Mississippi and its tributaries, with estimates of the cost of dams, dikes, canals and reservoirs.

19 **Babbitt,** F. E. Vestiges of glacial man in central Minnesota. Am. Assoc. Adv. Sci. 32:385-90. 1883.

20 **Bachèllery,** M. A. Les mines de fer du Minnesota. Annales des Mines. 9 sèr. 18:154-213. 1900.

Description gènèrale du Minnesota septentrional. Les minerals du Minnesota. Mèthodes d'exploitation. Conditions gènèrales de l'exploitation des mines.

21 **Bachman,** F. E. Mesabi ores and top explosions. Ir. Trd. Rev. 29:7. Ap.23,1896.

22 ———— The use of high percentages of Mesabi iron ores in coke blast-furnace practice. A. I. M. E. 35:977-85. 1905.

Reprint. Ir. Age. 74:10-11. My.26,1904.

Discussion of paper of W. A. Barrows.

23 **Bacon,** D. H. System of filling at the mines of the Minnesota Iron Co., Soudan, Minn. A. I. M. E. 21:299-304. diagrs. 1892.

Excerpt. E. and M. J. 64:306. S.1897.

24 **Bailey,** C. E. Mining methods of the Mesabi Range. A. I. M. E. 27:529-36. 1897.

Excerpt. Ir. Age. 60:2-3. Jl.29,1897.

25 **Baker,** J. H. Sources of the Mississippi; their discoverers, real and pretended. Minn. Hist. Soc. Coll. 6:1-28. 1887.

26 **Barlow,** A. E. On some dikes containing "huronite." Ottawa Nat. 9:25-47. 1895.

"Reviews the literature on huronite and describes the petrographic character of the rocks from various parts of Canada and from Minnesota, containing huronite."

27 **Barrows,** W. A. The Cuyuna district, South Range, iron ores. Ir. Trd. Rev. 51:923-24. N.14,1912.

"Tremendous deposits of high iron-bearing ores, of excellent physical structure," is the report.

28 ———— The use of high percentages of Mesabi iron ores in coke blast-furnace practice. A. I. M. E. 35:140-46. 1905.

Reprint. Ir. Age. 73:25-26. F.25,1904.

Paper reviewed by F. E. Bachman.

Barrows, W.A. *See also* Zapffe, Carl and Barrows, W. A. 873.

29 **Bartholomew,** W. I. Great achievements on the iron ranges. Ir. Trd. Rev. 46:53-60. illus. Ja.6,1910.

Reviews mining developments of the Mesabi and Vermilion Ranges, and describes the Trout Lake concentrating plant.

29a **Bassett,** R. H. New method of making sieve test. Ir.Trd. Rev. 57:230. diagr. Jl.29,1915.

Shows method of taking samples from stockpiles on the Mesabi Range for testing purposes.

30 **Bayley,** W. S. Actinolite magnetite schists from the Mesabe Iron Range in northeastern Minnesota. Am. Jour. Sci. 46:176-80. S.1893.

31 ———— Basic massive rocks of the Lake Superior region. Jour. Geol. 1:433-56, 587-96, 688-716; 2:814-25; 3:1-20. illus. 1893-95.

"Detailed petrographic descriptions of the gabbro and related rocks of northeastern Minnesota."

32 ————Eruptive and sedimentary rocks on Pigeon Point, Minnesota, and their contact phenomena. U. S. G. S. Bulletin 109. illus. maps. 1893.

Summary. U. S. G. S. Annual report for 1893-94. 15:101-03. 1895.

33 ————Fibrous intergrowth of augite and plagioclase, resembling a reaction rim, in a Minnesota gabbro. Am. Jour. Sci. 3d ser. 43:515-20. illus. 1892.

"Gives the petrographic results of a study of the Keweenawan gabbros in northeastern Minnesota."

34 ———— Notes on the petrography and geology of the Akeley Lake region, in northeastern Minnesota. M. G. S. for 1890. 19:193-210. 1892.

35 ———— On some peculiarly spotted rocks from Pigeon Point, Minnesota. Am. Jour. Sci. 3d ser. 35:388-93. My.1888.

Abstract. Nature. 38:91. 1888.

"Description of occurrence and petrography of the spotted quartzite and of the geologic relations of the associated rocks, and discussion of the nature and origin of the spots."

36 ———— Origin of the soda-granite and quartz-keratophyre of Pigeon Point. Am. Jour. Sci. 3d ser. 39:273-80. Ap.1890.

"Petrography, geologic relations, chemico-mineralogic history, and contact relations."

37 ———— Quartz-keratophyre from Pigeon Point, and Irving's augite-syenites. Am. Jour. Sci. 3d ser. 37:54-63. Ja.1889.

Abstract. Nature. 36:310. 1889.

"Brief discussion of history, relations and identity of the various masses."

38 **Bayliss,** Willard, **McNeil,** E. D., and **Lutes,** J. S. Mining methods on the Missabe iron Range. L. S. M. I. 18:133-54. illus. maps. 1913.

Excerpt. E. and M. J. 96:578-80. S.27,1913.
Excerpt. Ir. Trd. Rev. 53:450-53. S.11,1913.
Excerpt. Min. Wld. 39:551-55. S.27,1913.

Detailed description of the underground, open pit and milling methods of mining.

39 **Bechdolt,** A. F. Notes on the local geology of Mankato. Minn. Acad. Sci. Bull. 3:58-63. 1889.

Gives notes on clay deposits, formerly thought to be Cretaceous.

40 **Beltrami,** G. C. A pilgrimage in Europe and America, leading to the discovery of the Mississippi and Bloody River, with a description of the whole course of the former and of the Ohio. 2v. London, 1828.

41 **Berglund,** Abraham. The United States steel corporation. A study of the growth and influence of combination in the iron and steel industry. New York, 1907.

Gives concise information of the iron ore property owned or controlled by the United States steel corporation in Minnesota.

42 **Berkey,** C. P. Chemical analysis of the Fisher meteorite. Am. Geol. 20:317-18. N.1897.

43 ———— Geology of the St. Croix dalles. Am. Geol. 20:345-83; 21:140-55, 270-94. illus. map. D.1897,Mr., My.1898.

The area described covers sixty square miles, twenty square miles of which are in Minnesota, the remaining in Wisconsin.

44 ———— Guide to the Dalles of the St. Croix for excursionists and students. Minneapolis, 1898.

"Describes the geologic history and structure of the region physiographic and erosion features, and the character and occurrence of Cambrian strata and igneous rocks."

45 ———— Notes on Minnesota minerals. M. G. S. for 1894. 23:194-202. 1895.

"Contains notes on minerals from amygdaloidal diabase, with a chemical analysis of the rock, and a description and chemical analysis of apophyllite, laumonite, strigovite, datolite, travertine and marl."

46 ———— Origin and distribution of Minnesota clays. Am. Geol. 29:171-77. Mr.1902.

Abstract. Minn. Acad. Sci. Bull. 4:241-42. 1906.

Describes the occurrence of the Ordovician, Cretaceous and glacial clays.

47 ———— Paleogeography of Saint Peter time. Geol. Soc. Am. Bull. 17:229-50. Je.8,1906.

"Discusses the general character, distribution and stratigraphic position of the Saint Peter sandstone, the textural structure and origin of the material, and the paleogeography of Saint Peter time."

48 ———— Preliminary report of leveling party. M. G. S. for 1893. 22:134-40. 1894.

Physical geography of Cook County.

49 ———— Sacred Heart "geyser spring." Am. Geol. 29:87-88. F.1902.

50 ———— Some geological features of the vicinity of Franconia. (Abstract.) Minn. Acad. Sci. Bull. 4:194. 1906.

Berkey, C. P. *See also* Eby, J. H., and Berkey, C. P. 131.

51 **Beyer,** S. W. The Sioux quartzite and certain associated rocks. Iowa. Geological survey. Reports and papers. 6:69-112. geol. map. 1896.

The region studied includes northern Iowa, southern Minnesota, and eastern Dakota.

52 **Bierbauer,** Bruno. A check list of the Paleozoic fossils of Wisconsin, Minnesota, Iowa, Dakota, and Nebraska. Minn. Acad. Sci. Bull. 3:206-47. 1892.

53 **Birkinbine,** John. Beneficiating iron ores. Ir. Trd. Rev. 48:265-72. F.2,1911.

A general article, not confined to Minnesota practice, of various processes for enriching ores.

54 ———— Commerce on the great American lakes. Cassier's magazine. 11:487-501. Ap.1897.

55 ———— Complete average cargo analysis of [Mesabi and Vermilion,] iron ores. U. S. G. S. Mineral resources, 1900-1907.

Analysis given by mines.

56 ———— From mine to furnace. Cassier's magazine. 4:163-74, 243-56, 345-54, 425-35. Jl.-O.1893.

Miscellaneous references to Minnesota mining practice and transportation problems.

57 ———— Iron ore and mining operations. Ir. Trd. Rev. 48:49-63. illus. Ja.5,1911.

The greater part of this article deals with the whole Lake Superior district, the ores, their occurrence, development and analysis. Many references to Minnesota are given.

58 ———— Lake Superior iron ranges. Ir. Trd. Rev. 29:18-20. Ja.2,1895.

Compares the advantages of the ranges, the water hauls, physical structure of the ores, and size of deposits.

59 ———— Minnesota iron ores. U. S. G. S., Mineral resources. 1905:68-70.

Notes on mining methods, steam shovels, and the suit for ore lands by the state.

60 ———— Resources of the Lake Superior region. A. I. M. E. 16:168-203. illus. map. 1887.

Special mention of Vermilion Range, pp.179-84.

61 **Blakeley,** Russell. History of the discovery of the Mississippi River. Minn. Hist. Soc. Coll. 8:303-75. 1898.

62 **Blanchard,** R. Handbook of Minnesota. Chicago, 1867. (not seen.)

Bolster, R. H. *See* Covert, C. C., and Bolster, R. H. 98; Covert, C. C., Horton, A. H., and Bolster, R. H., 99; Follansbee, Robert, Horton, A. H., and Bolster, R. H., 178; Horton, A. H., Chandler, E. F., and Bolster, R. H., 296.

63 **Brackenbury,** Cyril. Mesabi Range, Minnesota. M. and M. 21:150-52. illus. N.1900.

Discusses the open pit, caving and milling methods of mining. Reprinted from the Daily mining gazette, Houghton, Michigan.

64 **Brinsmade,** R. B. The great iron fields of the Lake Superior district. Min. Sci. 58:425-27, 444-46, 465-68, 484-85, 505-07, 528-30; 59:4-7, 127-29 149-51, 304-05, 325-27. illus. 1908-09.

A series of articles dealing with mining methods, costs, geology, transportation and allied subjects. The Vermilion Range is given special attention on pp. 465-67, 484-85, and the Mesabi Range on pp. 505-07, 528-30.

65 ———— Mining without timber. New York, 1911.

Contains chapters illustrating Minnesota methods as follows:

Mesabi iron Range, pp.64-72,216-17.

Discusses prospecting, surveying, drainage, stripping, locomotives, steam shovels, sampling, assaying and mining methods.

Milling or "Glory-hole" system, pp.85-87.

Pioneer mine, Ely, Minnesota, pp. 183-86.

An example of back-caving into chutes.

Minnesota mine, Soudan, pp. 121-24.

Overhand stoping on waste with filling from a descending hangwall.

66 **Brower,** J. V. Memoirs of explorations in the basin of the Mississippi. 7v. illus. charts. St. Paul, 1898-1903.

67 ———— The Mississippi River and its source. St. Paul, 1893. (Minn. Hist. Soc. Coll., v. 7.)

A narrative and critical history of the discovery of the river and its headwaters, accompanied by the results of detailed hydrographic and topographic surveys.

68 ———— Prehistoric man at the headwaters of the Mississippi River. Minn. Hist. Soc. Coll. 8:232-69. 1896.

69 **Burchard,** E. F. Stone (in Minnesota). U. S. G. S. Mineral resources, 1912:2:757-64. map. 1913.

Notes on the distribution of granite, sandstone, limestone and a directory of stone quarries.

70 ———— Structural materials available in the vicinity of Minneapolis. U. S. G. S. Bulletin 430:280-91. 1910.

Includes brief notes on the rocks available at St. Cloud, Ortonville, Kettle River, Kasota and Mankato.

71 **Butcher,** E. W. R. Novel shower bath at Minnesota iron mine. E. and M. J. 97:223. Ja.24,1914.

72 ———— Some details of Mesabi Range mining. E. and M. J. 94:781. O.26,1912.

72a ———— Track work in a Minnesota mine on the Mesabi Range. E. and M. J. 96:352-53. illus. Ag.23,1913.

73 **Butcher,** F. F. Joplin jigs for iron ore. E. and M. J. 97: 432. F.21,1914.

Diagrams show quantitative flow sheet of Joplin jigging tests on five and one-half tons of Minnesota hematite.

C

74 **Carlyle,** E. J. Pioneer iron mine, Ely. Can. Min. Inst. Jour. 7:335-67. illus. Mr.,1904.

An account of the character, occurrence and geologic relations of the iron ore deposits.

75 **Carver,** Jonathan. Travels through the interior parts of North America in the years 1766, 1767, and 1768. London, 1778.

"Mr. Carver was the first to attempt any description of the rocks of this (southeastern Minnesota) area."

76 **Catlin,** George. Account of a journey to the Coteau des Prairies, with a description of the red pipestone quarry and granite boulders found there. Am. Jour. Sci. 1st ser. 38:138-46. 1840.

77 **Cayeux,** L. Existence de restes organiques dans les roches ferrugineuses associées aux minerais de fer huroniens des États-Unis. Acad. Sci. Paris, Compt. rend. 153:910-12. N.6,1911.

"Describes the occurrence of organic remains in Huronian iron-bearing rocks of the Lake Superior region."

78 **Chamberlain,** P. F. Concrete shaft at Tower, Minn. Eng. Rec. 62:556-57. diagrs. N.12,1910.

An account of the method used in sinking through wet soil.

79 **Chamberlain,** R. T. Glacial features of the St. Croix Dalles region. Jour. Geol. 13:238-56. maps. Ap.-My.1905.

Briefly reviews the work of other geologists in this region, and summarizes the results

80 **Chamberlin,** T. C. The bearing of some recent determinations on the correlation of the eastern and western moraines. Am. Jour. Sci. 3d ser. 24:93-97. 1882.

81 ———— On the extent and significance of the Wisconsin Kettle moraine. Wis. Acad. Sci. Trans. 4:201-34. 1878.

82 ———— and **Salisbury,** R. D. Preliminary paper on the driftless area of the upper Mississippi Valley. U. S. G. S. Annual report for 1884-85. 6:199-322. geol. maps. 1885.
Abstract. Science. 10:306-07. 1887.
Abstract. Am. Geol. 1:122-25. F.1888.

83 ———— Preliminary paper on the terminal moraine of the second glacial epoch. U. S. G. S. Annual report for 1881-82. 3:291-402. 1883.

Moraine of the Minnesota Valley glacier, pp.382-84,388-93.

84 ———— Terminal moraine west of Ohio. (Abstract.) Science. 2:317-18. S.7,1883.

Chandler, E. F. *See* Horton, A. H., Chandler, E. F., and Bolster, R. H. 296.

85 **Chaney,** L. W. Cryptozoon minnesotense in the Shakopie limestone at Northfield, Minn. Minn. Acad. Sci. Bull. 3:280-84. diagrs. 1892.

86 **Channing,** J. P. Lake Superior iron ore. Mineral Industry. 3:375-402. tables. diagrs. 1894.

Vermilion Range pp.390-95, Mesabi Range pp.395-402. Diagrams show method of top-slice and sub-drift system of caving.

86a **Charlton,** D. E. Accident prevention on the Mesaba Range. Michigan College of mines. Alumnus. 4:109-21. Ap.1915.

86b ———— Cover for shaft ladderway. E. and M. J. 100:269. diagr. Ag.14,1915.

86c ———— Rock- and ore-chute door. E. and M. J 100:226-27. diagr. Ag.7,1915.

Describes a temporary arrangement used on the Mesabi Range for hoisting ore from an unfinished shaft without interfering with the hoisting of rock.

86d ———— Safety staging hook. E. &. M. J. 100:311. diagr. Ag.21,1915.

87 **Chatard,** T. M. Brick clay from New Ulm. (Analyses.) U. S. G. S. Bulletin 60:151. 1890.

87a **Cheney,** C. A. Structure of the Cuyuna iron-ore district of Minnesota. E. &. M. J. 99:1113-15. map. Je.26,1915.

Discusses the problems of the occurrence and the genesis of the ores.

88 **Chester,** A. H. Iron region of northern Minnesota. M. G. S. for 1882. 11:154-67. 1884.

"Describes the rocks of the Vermilion and Mesabi Ranges." This is reported to be the first examination of the Mesabi Range by a mining expert.

Clark, Thomas. *See* Anderson, C. L. and Clark, Thomas, 10; Hanchett, A. H. and Clark, Thomas, 273.

Clarke, E. S. *See* Herrick, C. L., Clarke, E. S. and Deming, J. L. 283.

89 **Clarke,** Hopewell. Source of the Mississippi. Being a report by Hopewell Clarke, Chief of the Iveson, Blakeman, Taylor and Co.'s expedition to the headwaters of the Mississippi. Contains also a letter from Messrs, Iveson, Blakeman, Taylor and Co. Science. 8:599-611. map. D.24,1886.

90 **Clarke,** J. M. The Lower Silurian Cephalopoda of Minnesota. M. G. S. Final report. 3:2:761-812. plates. 1897.

91 ———— The Lower Silurian trilobites of Minnesota. M. G. S. Final report. 3:2:695-759. plates. 1897.

The terminology of the trilobites is given, with notes and descriptions of new species..

92 **Clarke,** J.M. Nanno, a new cephalopoden type. Am. Geol. 14:205-08. O.1894.

"The material described was obtained from the Trenton shales of Minneapolis, and the Galena shales at Chatfield."

93 **Claypole,** E. W. Eccentricity theory of glacial cold versus the facts. Edin. Geol. Soc. Trans. 5:534-48. 1888.

Brief mention of the rate of recession of St. Anthony Falls, and the history of the drainage of the upper Mississippi.

94 **Clements,** J. M. Vermilion iron-bearing district of Minnesota. U. S. G. S. Monograph 45. 1903. 463p., with atlas of 26 plates.
Review. M. and M. 24:546-47.Je.1904.
Abstract. Sperulitic texture in the Archean greenstones. Geol. Soc. Am. Bull. 14:9,555. 1903.
Abstract. Ir. Trd. Rev. 36:42. F.19,1903.

"Reviews the literature regarding the district, describes its physiography, the character, occurrence and relations of the Archean, Huronian and Keweenawan rocks and drift, and the occurrence, character and origin of the ore deposits."

Clements, J. M. *See also* Van Hise, C. R., Leith, C. K., and Clements, J. M. 597.

95 **Coleman,** A. P. Copper and iron regions of Ontario. Ontario Bureau of Mines. Report 1900:143-91. 1901.

Brief note on the Mesabi and Vermilion Ranges pp.152-54.

95a **Collins,** E. J. Drying iron ore on the Mesabi Range. Michigan College of mines, Alumnus. 3:144-48. O.1914.
Abstract. E. and M. J. 99:696-97. Ap.17,1915.

96 **Comstock,** E. H. Maps of the mining districts of Minnesota. Minn. School of Mines Exp. Station. $1.00.

Includes maps of the Vermilion, Mesabi and Cuyuna Ranges, lists the producing mines, and gives mine ownerships.

97 **Concklin,** B. M. Special method of mining on dangerous ground on the Mesabi Range. Wis. Eng. 16:326-27. Ap.1912.
Reprint. Min. Sci. 65:413. My.9,1912.
Reprint. Min. Wld. 36:1098. My.25,1912.
Reprint. E. amd M. J. 93:1219. Je.22,1912.
Reprint. E. and M. J. Handbook of mining details. pp.127-28, 1912.

98 **Covert,** C. C. and **Bolster,** R. H. Streams tributary to Lake Superior. U. S. G. S. Water supply papers. 304:15-24. 1911.

99 ———— **Horton,** A. H. and **Bolster,** R. H. St. Louis River drainage basin. U. S. G. S. Water supply papers. 264:31-35. 1909, also 284:23-36. 1910.

100 ———— **Horton,** A. H. and **Hoyt,** W. G. Streams tributary to Lake Superior. U. S. G. S. Water Supply papers. 324:15-28. 1912.

101 **Crane,** W. R. Ore mining methods. New York, 1910.

Working by sub-drifting as employed at the Susquehanna minc at Hibbing. pp.139-41.

101a **Cronk,** F. B. Shaft sinking on the Mesabi Range. Wis.Eng. 19:297-98. diagrs. Ap.1915.
Abstract. E. and M. J. 99:1119. Je.26,1915.

Gives details of temporary and permanent headframes.

102 **Crowell,** Benedict. Concentrating at the Madrid mine. L. S. M. I. 18:129-32. diagrs. 1913.
Reprint. Min. Wld. 39:518. S.20,1913.

A Wetherbee concentrator is used in this concentrating plant, located at Virginia, Minnesota.

103 **Crowell** and **Murray.** Iron ores of Lake Superior, containing some facts of interest relating to mining and shipping of the ore and location of principal mines. 2d ed. maps. Cleveland, 1914.

Treats of geology, history of mining, sampling, analysis, pricing and transportation. Contains a directory of Minnesota mines.

104 **Croze,** W. W. J. Minnesota's great iron mining industry. Min.Wld.33:717-21. illus. map. O.15,1910.

Paper prepared for the Conservation Congress, held in St. Paul.

105 **Culver,** G. E. Notes on the geology of Itasca County. M. G. S. for 1893. 22:97-114. 1894.

"Describes the topography of the region and the megascopic characters of the granite, diorite and greenstones, and the glacial phenomena."

D

106 **Dale,** T. N., and others. Minnesota (slate deposits and slate industry). U. S. G. S. Bulletin 275:70,126-31. 1906, also 586:86,196-97. 1914.

107 **Daly,** R. A. Secondary origin of certain granites. Am. Jour. Jour. Sci. 4th ser.20:185-216. 1905.

Minnesota granites, pp.196-202.

108 **Dana, J. D.** Note on the former southward discharge of Lake Winnipeg. Am. Jour. Sci. 3d ser.24:428-33. 1882.
Reprint. Canadian Naturalist. n.s.10:436-42. 1883.
Abstract. Science. 1:19. 1883.

109 ———— On the driftless interior of North America. Am. Jour. Sci. 3d ser.15:250-55. 1878.

Accounts for the absence of glacial drift on the ground of the dryness of the climate in connection with the heat of the summer. Chart shows annual precipitation for this area.

110 **Darton,** N. H. Preliminary list of deep borings in the U. S. U. S. G. S. Water supply papers. 57:55-57. 1st ed. 1902, also 149:70-72. 2d ed. 1905.

111 **Darton,** N. H. Preliminary report on the geology and underground water resources of the central Great Plains. U. S. G. S. Professional paper 32. 1905.

Many scattered references to the geology, petrology, paleontology and water resources of Minnesota.

112 **Davenport,** L. D. Caving system in Chisholm district. E. and M. J. 94:437-39,511-13,559-60. illus. S.7,14,21. 1912.

The method of developing a mining property in this district is illustrated by the use of an hypothetical mine.

112a ———— Inclined shaft for timber on the Mesabi. E. and M. J. 99:776-77. diagrs. My.1,1915.

112b ———— Reinforced concrete shaft sets. E. and M. J. 99:447-48. illus. diagrs. Mr.6,1915.

Describes a concrete plant at Hibbing for making shaft sets, gives the flow sheet, and shows method of placing the sets.

113 ———— Shaft timbering in Minnesota iron mines. E. and M. J. 94:830-31. diagrs. N.2,1912.

114 ———— Top set slicing in the Chisholm district. E. and M. J. 95:276-77. diagrs. F.1,1913.

Diagrams show unsatisfactory and improved methods of slicing.

114a ———— Unwatering Carson Lake. E. and M. J. 98:1069-70. illus. D.19,1914.

115 **Davis,** W. M. Gorges and waterfalls. Am. Jour. Sci. 3d ser.28:123-32. 1884.

Origin of the Falls of St. Anthony and of Minnehaha Falls, pp.126-27.

116 ———— On the classifications of lake basins. Boston Soc. Nat. Hist. 21:315-81. Ja.4,1882.
Abstract. Am. Nat. 16:1028-29. 1882.
Abstract. Am. Jour. Sci. 3d ser.24:230. 1882.

Many scattered references to Minnesota lakes.

117 **Dawson,** G. M. Bowlder clays. On the microscopic structure of certain clays and organisms contained in them. M. G. S. for 1884. 13:150-63. 1885.

Bowlder clays from Meeker County, pp.155-56.

118 ———— On the superficial geology of the central region of North America. Geol. Soc. Quar. Jour. 31:603-23. map. 1875.

Northern Minnesota, pp.609-16.

Deming, J. L. *See* Herrick, C. L., Clarke, E. S., and Deming, J. L. 283.

119 **Denton,** F. W. Fayal iron mine on the Mesabi Range. E. and M. J. 64:275-77. diagrs. S.4,1897.

Diagrams show the map of the mine, timbering of pockets and station, underground chute and stull rooms.

120 **Denton,** F.W. Methods of iron mining in northern Minnesota. A.I.M.E. 27:344-90. map. illus. tables. 1897.

Describes in detail a number of mines on the Mesabi and Vermilion Ranges.

121 ———— Open-pit mining, with special reference to the Mesabi Range. L.S.M.I. 3:84-92. 1895.

122 **DeWolfe,** E. C. Electric haulage on the iron ranges. Min. Wld. 41:425-30. illus. S.5, 1914.

The haulage work in the mines at Ely is described.

123 **Dickenson,** G. L. Report on Isle Royale. 31st Congress, 1st Session, H.E.Doc.no.5,pt.3:503-06. 1849.

124 **Dole,** R. B. Mineral analysis of water from the Minnesota and Mississippi Rivers. U.S.G.S. Water supply papers. 236:74-75,117. 1909.

125 ———— and **Wesbrook,** F. F. The quality of surface waters in Minnesota. U.S.G.S. Water supply papers. 193. 1907.

126 **Donovan,** P. W. Churn-drill angle holes on the Cuyuna. E. and M. J. diagrs. 96:1117-18.

Explains the necessity of new boring methods.

126a ———— Deep diamond-drill hole with light equipment. E. and M. J. 97:659-60. Mr.28,1914.

Gives core section of a drill hole on the Mesabi Range.

127 **Drake,** Frank. The use of steel in lining mine shafts. L.S.M. I. 8:34-61 diagrs.tables. 1902.
Abstract. E.and M.J. 74:338-40. S.13,1902.

Detailed descriptions of the "B" shaft of the Pioneer mine, Ely, the "A" shaft, Norris mine, and the proposed new shaft, Chapin mine. Tables show items of cost.

128 **Durrie,** D. S. Captain Jonathan Carver, and "Carver's grant." Minn.Hist.Soc.Coll. 8:220-70. 1872.

An account of the explorations of Carver, and the correspondence relating to the grant by the Indians of a tract of land near St. Anthony Falls.

E

129 **Eames,** H. H. Geological reconnoissance of the northern, middle, and other counties of Minnesota. Second report of the state geologist of Minnesota. St.Paul, 1866. 58p.

130 ———— Metalliferous region bordering on Lake Superior. First report of the state geologist of Minnesota. St. Paul, 1866. 23pp.

131 **Eby,** J. H., and **Berkey,** C. P. Copper minerals in hematite ore. L.S.M.I. 4:69-79. 1896.
Reprint. U. of M. Eng. Soc. 5:108-117. My.1897.

Describes the occurrence of a number of copper minerals in the hematite ore of the Montana mine, Soudan.

132 **Eby,** J. H. System of mine discipline and bonus. Min.Wld. 40:411-12. F.28,1914.

Describes the results of this system used in the iron mines of Minnesota.

133 ———— Unusual problem in open-pit mining. E. and M. J. 98:609-10. O.3,1914.

An abstract of an article appearing in the Michigan College of Mines Alumnus, which deals with selective mining.

134 **Eckel,** E. C. Cement materials and industry in [Minnesota.] U.S.G.S. Bulletin 243:344-45,206. 1905.

135 ———— Iron ore reserves. Eng.Mag. 43:665-74,825-36; 44:7-15. Ag.-0,1912.

Brief mention of Minnesota ranges. Discusses actual extent and probable duration, with three logical bases for valuation.

136 ———— Iron ores, their occurrence, valuation and control. New York,1914.

Contents. Origin of iron ore deposits. Valuation of iron ore properties. Iron ores of the world. Extent and control of iron ore reserves.

Contains much valuable material on the Minnesota iron ore deposits.

137 ———— Ore mining costs in the Lake district. Lake Superior iron ore annual. 1913:7-16. tables. 1913.

Gives cost per ton 1902-06 and compares with costs for 1907-10.

138 ———— Portland cement resources of [Minnesota.] U.S.G.S. Bulletin 522:224. 1913.

139 **Edwards,** G. E. Development of the Vermilion iron Range. Min.Wld. 39:595-96. illus. O.4,1913.

Brief account of mining methods and nature of the deposits.

140 ———— Estimation on Lake Superior iron ore reserves. Min.Wld. 30:693-94. Ap.10,1909.

"Gives opinions of a number of experts on the almost boundless extent of the deposits and discusses matters that affect the cost of mining."

141 ———— Iron. Min.Wld. 34:163-66. Ja.21,1911.

Statistics of production and of shipments are given, with a detailed description of the Trout Lake concentrating plant.

142 ———— Iron. Min.Wld. 36:217-20. Ja.27,1912.

Review of progress on the ranges for 1911.

143 ———— Lake Superior iron. Min.Wld. 32:180-85. Ja.22,1910.

144 ———— Lake Superior iron. Min.Wld. 38:188-93. Ja.25,1913.

145 ———— Lake Superior iron mining. Min.Wld. 35:856. O.28,1911.

146 ———— Lake Superior mine disasters. Min.Wld. 34:690. Ap.1,1911.

147 **Edwards,** G. E. Rapid development of the Cuyuna Range. Min.Wld. 39:339-41. Ag.23,1913.

An account of the mines in operation, and their output.

147a ———— Review of progress on the Lake Superior iron ranges in 1914. Min.Wld. 42:449-59. illus. Mr.6, 1915.

148 ———— Season's development on the iron ranges. Min. Wld. 39:825-28. N.8,1913.

149 ———— Towns built on an iron ore foundation. Min.Wld. 28:65-66. Ja.11,1908.

150 **Elftman,** A. H. Geology of the Keweenawan area in northeastern Minnesota. Am.Geol. 21:90-109,175-88; 22:132-49. map. F.,Mr.,S.,1898.

"This report includes a detailed description of the contact effect of the gabbro on the underlying rocks. The glacial history of the northern part of the state is reviewed."

151 ———— Highland Range in Minnesota. E. and M.J. 75:447-48. Mr.21,1903.

152 ———— Keewatin and Laurentine ice sheets in Minnesota. (Abstract) Geol.Soc.Am.Bull. 13:536-37. F.27,1903.

153 ———— List of rock samples collected in northeastern Minnesota in 1895, 1896 and 1897. M. G. S. for 1895-98. 24:150-70. 1899.

List prepared by U. S. Grant.

154 ———— Notes upon the bedded and banded structures of the gabbro and upon an area of troctolyte. M. G. S. for 1894. 23:224-30. 1894.

155 ———— Ore deposits in Minnesota. U. of M. Eng. Soc. 4:115-17. My.1896.

Notes on all the ores known to exist in the state.

156 ———— Preliminary report of field work during 1893 in northeastern Minnesota. M. G. S. for 1893. 22:141-80. maps. 1894.

"Detailed petrographic descriptions of the actinolite-magnetite-schists of the iron formation on Birch Lake and southwestward."

157 ———— Preliminary report of field work during the summer of 1895. M. G. S. for 1895-98. 24:148-49. 1899.

Brief notes on the occurrence of anorthosytes.

158 ———— The St. Croix River Valley. Am. Geol. 22: 58-61. Jl.1898.

"Describes the relation of the preglacial and postglacial courses of the river." (Minnesota-Wisconsin.)

159 **Emmons,** W. H. Outline of the geology of the iron ranges. In Iron mining in Minnesota, by C. E. van Barneveld, pp.12-23. diagrs.map. 1912.

159a **Estep,** H. C. How Carson Lake was drained. Ir. Trd. Rev. 56:128-29. map. Ja.14,1915.

159b **Estep,** H.C. Independents are conspicuous. Ir. Trd. Rev. illus.tables. 56:73-81. Ja.7,1915.

A review of developments on the Minnesota ranges in 1914.

160 ———— Review of Lake Superior iron range developments Ir. Trd. Rev. 52:101-06. illus.tables. Ja.2,1913.

161 ———— Quiet year on the Minnesota iron ranges. Ir. Trd. Rev. 50:26-36. illus.map. Ja.6,1912.

162 ———— Year's developments on Minnesota iron ranges. Ir. Trd. Rev. 54:90-102. table. Ja.1,1914.

Table gives shipments of principal Minnesota mines for 1912 and 1913, with a complete summary of the year's work, and the Minnesota Tax Commission's method of taxation.

F

163 **Fawcett,** Waldon. Comparison of costs in iron ore handling and transportation. Ir. Age. 67:11-12. Mr.21,1901.

164 ———— The mining of iron. Century. 61:712-25. illus. Mr.1901.

165 ———— Transportation of iron. Century. 61:851-63. illus. Ap.1901.

166 **Fay,** A. H. Iron mining at Coleraine, Minn. E. and M. J. 88:770-71. illus. O.16,1909.

A brief description of the Canisteo mine, followed by notes on concentrating the sandy ores, the milling equipment, and a flow sheet of the mill.

167 ———— Notes on the caving system in northern iron mines E. and M. J. 88:961-63. illus.diagrs. N.13,1909.

Describes the method of caving in use on the Mesabi Range.

168 ———— Notes on the milling system of mining. E. and M. J. 88:919-20. illus.diagrs. N.6,1909.

Sketch shows the general arrangement of drift and mill holes.

169 ———— Sinking a reinforced concrete mine shaft. E. and M. J. 88:599-601. illus. diagrs. S.25,1909.

The Morton mine shaft at Hibbing is described. Gives the estimated cost as $500 per foot.

170 ———— Steam shovel work on the Mesabi Range. E. and M. J. 91:420-23.. illus.map. F.25,1911.

Gives details of operations which exceeds the work on the Panama Canal in amount of overburden moved annually. Brief notes on some of the mines.

171 **Featherstonhaugh,** G. W. Canoe voyage up the Minnay Sotor. 2v. London,1847.

See chapters 26 and 27. Mr. Featherstonhaugh was "the first commissioned geologist who ever visited Minnesota."

172 ———— On the excavation of the rocky channels of rivers by the recession of their cataracts. British Assoc. Adv. Sci. Transactions of the sections. 14:45-46. 1845.

173 **Featherstonhaugh,** G.W. Report of a geological reconnaissance made in 1835 from the seat of government by the way of Green Bay and the Wisconsin Territory to the Coteau du Prairie, an elevated ridge dividing the Missouri from the St. Peters River. Washington, 1836. 168p.

174 **Finlay,** J. R. Cost of mining Lake Superior iron. In his Cost of mining. pp.85-121. New York, 1909.

Discusses the capital employed, royalties, taxes, consolidation, transportation, cost of open pit mining, selling cost of pig iron, and gives statistics regarding the United States Steel Corporation, its profits, plants, and property.

175 ———— Cost of pig iron made from Lake Superior ores. E.and M.J. 87:739-45. map. Ap.10,1909.

Deals with the output of the various districts, the capital employed, costs on the Mesabi, royalties, unwatering costs, taxes, and transportation.

176 ———— Valuation of iron mines. A.I.M.E. 45:282-97. 1913.

Abstract of discussions on this paper. Min.Wld. 38: 1143-46. Je.14,1913.

An article dealing mainly with Michigan, but which throws light on the whole Lake Superior district.

Finlay, J. R. *See also* Smyth, H. L. and Finlay, J. R. 485.

177 **Follansbee,** Robert, **Horton,** A. H. and **Jackson,** H. J. Red River basin, Rainy River basin and upper Mississippi drainage basin. U.S.G.S. Water supply papers. 305: 23-153. 1911.

178 ———— **Horton,** A. H. amd **Bolster,** R. H. Red River drainage basin, Rainy River drainage basin, upper Mississippi River drainage basin. U.S.G.S. Water supply papers. 265:42-174. 1909.

179 ———— **Horton,** A. H. and **Stevens,** G. C. Red River drainage basin and upper Mississippi drainage basin. U. S. G. S. Water supply papers. 285:31-270. 1910.

180 **Foster,** J. W. and **Kimball,** J. P. Geology and metallurgy of the iron ores of Lake Superior. New York, 1865. 97p. (Not seen.)

181 ———— and **Whitney,** J. D. Geology of the Lake Superior land district. Part 2. The iron region. 31st Congress, Special session, S.E.Doc.no.4. Washington, 1851. Chapters by James Hall, E. Desor and Charles Whittlesey. Extracts. Am.Jour.Sci. 2d ser.15:295-96. 1853; 17:11-33. 1854.

182 ———— ———— On the Azoic system as developed in the Lake Superior land district. Am.Assoc. Adv.Sci. 5:4-7. 1851.

The region examined lies on the north shore of Lake Superior.

Fuller, M. L. *See* Hall, C. W., Meinzer, O. E., and Fuller, M. L. 249.

183 **Funk,** J. P. The great iron mines of Minnesota and their significance to the people of the state. map. St. Paul,n.d. 18p.

Paper read before the students of St. Paul's College, St. Paul Park.

184 ———— Iron mines of Minnesota. School, University and other state lands. Compiled in the office of the State Auditor. map. St. Paul, n. d. 16p.

Contents. Some facts relating to the iron mines located on Minnesota school, University and other state lands, also as to the great iron ranges in the state. The discovery of iron ore and development of mines thereon. Present status of the mining industry created. Benefits accruing to the citizens of the state on account of its wonderful iron mines.

G

185 **Gannett,** Henry. Altitudes [in Minnesota.] U.S.G.S. Bulletin. 5:147-54. 1st ed. 1884; 76. 2d ed.1891; 160: 320-44. 3d ed.1899; 274:472-501. 4th ed. 1906.

186 ———— Boundaries [in Minnesota.] U.S.G.S. Bulletin 13:118-19. 1st ed. 1885; 171:124-25. 2d ed. 1900; 226:125-26. 3d ed. 1904.

187 ———— Geographic positions [in Minnesota.] U.S.G.S. Bulletin. 123:115-16. 1895.

188 ———— Magnetic declination [in Minnesota.] U.S.G.S. Annual report for 1895-96. 17:1:364-67. 1896.

189 ———— Physiographic types. A region in youth, Fargo, N. D.-Minn. U.S.G.S.Folio 1.

190 **Gannett,** S. S. Geographic positions [in Minnesota.] U.S.G.S. Bulletin 245:87-93. 1905; 276:63-67. 1905.

191 **Garrison,** O. E. The upper Mississippi region. M.G.S. for 1880. 9:175-223. 1881.

This report deals with the topography of the region, the forests, rivers and lakes, and is complied from notes taken for the 10th census of the U. S. Department of forestry.

192 **Gerry,** A. L. Iron mining on the Mesabi Range. E.and M.J. 94:693-96. illus.diagrs. O.12,1912.

193 **Glazier,** Willard. Headwaters of the Mississippi. Rand, McNally & Co., 1894. (Not seen.)

194 **Gow,** A. M. Safety in mine operation. Mex.Min.Jour. 15:19-20 illus. Jl.1912.

Describes some of the safeguards used by the Oliver Iron Mining Co. on the Minnesota ranges.

195 ———— Some safety devices of the Oliver Iron Mining Co. L.S.M.I. 16:156-67. illus. 1911.

196 **Gow,** A. M. Standard boiler house of the Oliver Iron Mining Co. L.S.M.I. 13:209-24. diagrs. 1908.

Eight folded plates show design and equipment.

197 **Grant,** U. S. An account of a deserted gorge of the Mississippi near Minnehaha Falls. Am.Geol. 6:1-6. diagrs. Jl. 1890.

198 ——— Catalogue of rock specimens collected in northeastern Minnesota in 1892. M.G.S. for 1892. 21:59-67. 1893.

199 ——— Contact metamorphism of a basic igneous rock. Geol.Soc.Am.Bull. 11:503-10. Ag.10,1900.

200 ——— Eastern limit of glacial Lake Agassiz. Minn. Acad.Sci.Bull. 4:208. 1906.

201 ——— Field observations on certain granitic areas in northeastern Minnesota. M.G.S. for 1891. 20:35-110. map. 1891.

The areas visited and described are Kawishiwi River, Snowbank Lake, Kekequabic Lake and Saganaga Lake.

202 ——— Geology of Cook County. M.G.S. Final report. 4:313-45. illus.map. 1899.

The occurrence of the Archean and Cambrian rocks is described, also the glacial history and the drift deposits.

203 ——— Geology of Itasca County. M.G.S. Final report 4:166-92. illus.map. 1899.

204 ——— Geology of Kekequabic Lake in northeastern Minnesota, with special reference to an augite soda-granite. M. G. S. for 1892. 21:5-58. illus.diagrs.map. 1893.

Thesis accepted for degree of Ph. D. in Johns Hopkins University.

205 ——— Geology of the Akeley Lake plate. M.G.S. Final report. 4:462-80. diagrs.map. 1899.

206 ——— Geology of the Frazer Lake plate. M.G.S. Final report. 4:434-61. map. 1899.

207 ——— Geology of the Gabbro Lake plate. M.G.S. Final report. 4:399-419. illus.map. 1899.

208 ——— Geology of the Grand Rapids plate. M.G.S. Final report. 4:350-54. map. 1899.

"Describes the character and occurrence of the granites and the Cambrian sediments of the region."

209 ——— Geology of the Gunflint Lake plate. M.G.S. Final report. 4:481-90. illus.map. 1899.

210 ——— Geology of the Mountain Lake plate. M.G.S. Final report. 4:496-501. map. 1899.

Mentions the occurrence of silver in this district.

211 ——— Geology of the Pokegama Lake plate. M.G.S. Final report. 4:346-49. map. 1899.

212 **Grant,** U.S. Geology of the Rove Lake plate. M.G.S.Final report. 4:491-95. map. 1899.

213 ———— Geology of the Snowbank Lake plate. M.G.S. Final report. 4:420-33. map. 1899.

The Archean rocks and the drift deposits are described.

214 ———— Geology of the Swan Lake plate. M. G. S. Final report. 4:355-57. map. 1899.

"Discusses briefly the occurrence of granitic rocks and Cambrian deposits."

215 ———— International boundary between Lake Superior and the Lake of the Woods. Minn. Hist. Soc. Coll. 8:1: 1-10. 1895.

216 ———— Investigations of the Lake Superior iron ore deposits. Min. Mag. 10:175-83. illus.map. S.1894.

A general discussion of the whole Lake Superior district, including Wisconsin, Michigan and Minnesota.

217 ———— Lakes with two outlets in northeastern Minnesota. Am.Geol. 19:407-11. Je.1897.

"Describes the occurrence of several lakes of this character, and discusses the evidence of their probable duration."

218 ———— List of rock samples collected in northeastern Minnesota in 1898. M.G.S. for 1895-98. 24:145-46. 1899.

219 ———— Note on an augite soda-granite from Minnesota. Am.Geol. 11:383-88. Je.1893.

220 ———— Note on the Keweenawan rocks of Grand Portage Island, north coast of Lake Superior. Am.Geol. 13: 437-39. Je.1894.

221 ———— Notes on some water divides in northeastern Minnesota.(Abstract) Minn. Acad. Sci. Bull. 4:1:39-40. 1896.

222 ———— A possible driftless area in northeastern Minnesota. Am.Geol. 24:377-81. D.1899.

223 ———— Preliminary report of field work during 1893 in northeastern Minnesota. M.G.S. for 1893. 22:67-78. 1894.

Contents: The Keewatin. Iron-bearing rocks of Akeley Lake. The Animikie. The Keweenawan.

224 ———— Record of geological field work in northern Minnesota, 1892-1898. M.G.S. for 1895-98. 24:85-144. 1899.

225 ———— Report of geological observations made in northeastern Minnesota during the summer of 1888. M. G. S. for 1888. 17:149-215. 1889.

226 ———— Sketch of the geology of the eastern end of the Mesabi iron Range in Minnesota. U. of M. Eng. Soc. 1898:49-62. map. 1898.

"Describes the physiography, geologic history, occurrence of Animikie and pre-Animikie rocks, diabase sills and gabbro, and the occurrence of iron ores."

227 **Grant,** U.S. The state of Minnesota. Int. Cong. Geol. Compte Rendu, 5:302-17. 1893.

"Describes the topography, the outcrops of Archean and Algonkian, Cambrian and Silurian formations, and the glacial deposits of the portion of the state crossed by the excursion."

288 ———— The stratigraphic position of the Ogishke conglomerate of northeastern Minnesota. Am.Geol. 10:4-10. Jl.1892.

229 ———— Volcanic rocks in the Keewatin of Minnesota. Science. n.s.23:17. Ja.12,1894.

Grant, U. S. *See also* Winchell, H. V. and Grant, U. S. 674; Winchell, N. H. and Grant, U. S., 784, 822.

230 **Griggs,** R. E. The Buffalo River, an interesting meandering stream. Geog. Soc. Am. Bull. 38:168-77. Mr.1906.

"Discusses factors controlling the meandering of streams."

231 ———— Divided lakes in western Minnesota. Am. Jour.Sci. 4th ser.27:388-92. My.1909.

232 **Grout,** F. F. Composition of some Minnesota rocks and minerals. Science. n.s.32:312-15. S.2,1910.

233 ———— Contribution to the petrography of the Keweenawan. Jour.Geol. 18:633-57. illus.tables.map. O.1910.

234 ———— Keweenawan copper deposits. Econ.Geol. 5: 471-76. Jl.1910.

Results of studies carried on in the extreme southwestern part of the Keweenawan area.

235 ———— and **Soper,** E.K. Preliminary report on the clays and shales of Minnesota. illus.geol.map. Minneapolis. 1914. 172p. (M.G.S.Bulletin no.11.)

Contents: Introduction. Physical properties of clay. Classification and adaptability of clays. Technology of clays. Geology of Minnesota with special reference to clays. Distribution of types of clay in Minnesota. Clays of Minnesota by counties.

H

236 **Haight,** C. M. Steam shovel operation. E.and M.J. 97: 359-60. F.14,1914.

Notes on the size of shovels and ore cars, the conditions under which the shovel works, the track layout and the cost of steam shovel work.

237 ———— Stockpiling on the Mesabi. E.and M.J. 97: 271-73. Ja.31,1914.

"The extension of an old stockpile at the Harold Mine, necessitated the development of a new method to keep up the capacity of the equipment in the face of a larger haul."

238 ———— Storing timber in Mesabi mines. E.and M.J. 97:180. illus. Ja.17,1914.

239 **Hall,** C. M. and **Willard,** D. E. Casselton-Fargo folio, North Dakota-Minnesota. U.S.G.S.Folio 117. 1905.

"Describes the topography, drainage and general geology, the geologic history, including a brief account of Lake Agassiz, the character and occurrence of Quarternary deposits, discusses the underground water resources, and gives a large number of well records."

240 **Hall,** C. W. Brief history of copper mining in Minnesota. Minn.Acad.Sci.Bull. 3:105-11. 1889.

Contains notes on the extent of the Keweenawan in Minnesota.

241 ———— The deep well at Minneota. Minn.Acad.Sci. Bull. 3:248-50. 1892.

The well record is given, with a brief description of the strata.

242 ———— Distribution of the granites of the northwestern states, and their general lithologic characters.(Abstract). Am.Assoc.Adv.Sci. 37:189-90. 1889.

The Minnesota granites are given special mention.

243 ———— and **Sardeson,** F. W. Eolian deposits of eastern Minnesota. Geol.Soc.Am.Bull. 10:349-60. illus.diagrs. N.1899.
Abstract. Am.Geol. 23:103. F.1899.
Abstract. Science. n.s.9:143. 1899.

244 **Hall,** C. W. Extent and distribution of the Archean in Minnesota.(Abstract). Science, n.s.9:412-13. Mr.17,1899.

245 ———— Field report on Lake Superior region. M.G.S. for 1878. 7:26-29. 1879.

246 ———— Formation and deformation of Minnesota lakes. Sci.Am.Supp. 36:14625-26. Jl.15,1893.

The glacial lakes of northern Minnesota are described.

247 ———— The geography and geology of Minnesota. illus. Minneapolis,1903. 299p.

248 ———— Geological conditions which control artesian well borings in southeastern Minnesota. Minn.Acad.Sci.Bull. 3:128-43. 1889.
Abstract. Am.Assoc.Adv.Sci. 39:264. 1890.

The stratigraphy of the region is shown by well records.

249 ———— **Meinzer,** O. E. and **Fuller,** M. L. Geology and underground waters of southern Minnesota. U.S.G.S. Water supply papers, no.256. geol.map. 1911.

250 **Hall,** C. W. Geology of Minnesota. Int.Min.Cong.Proc. 4th session, pp.165-71. 1901.
Reprint. M.and M. 23:532-34. Jl.1903.

"Describes the geologic formations of the state and the occurrence of economic minerals in each ol them."

251 ———— Gneisses, gabbro schists, and associated rocks of southwestern Minnesota. U.S.G.S. Bulletin no. 157. geol.maps. 1899.

252 **Hall,** C. W. Keewatin area of eastern and central Minnesota. Geol.Soc.Am.Bull. 12:343-76. illus.geol.map. Ag.1901.

253 ———— Keewenawan area of eastern Minnesota. Geol. Soc.Am.Bull. 12:313-42. illus.map. Ag.1901.

254 ———— Lithological characters of the Trenton limestone of Minneapolis and St.Paul, with a note on the borings of the West Hotel artesian well. Minn.Acad.Sci.Bull. 3:111-24. 1889.

"Detailed description of Trenton and underlying St. Peters sandstone in the vicinity of the city. References to glacial striae and thickness of drift."

255 ———— and **Sardeson,** F. W. Magnesian series of the northwestern states. Geol.Soc.Am.Bull. 6:167-98. map. Ja.1895.

The lithological and paleontological charactertistics are noted.

256 **Hall,** C. W. Material conditions of a municipal water supply. (Abstract) Science. n.s.33:468-69. Mr.24,1911.

The Minneapolis and St. Paul water supply is the basis of this article.

257 ———— Mineral alterations in the granitic rocks of the northwestern states.(Abstract). Am.Assoc.Adv.Sci. 43:236. 1895.

The granites of Minnesota and Wisconsin are discussed.

258 ———— Minnesota, a sketch. Jour.Geog. 1:241-49. illus. Je.1902.

A general descriptive article, dealing with the main topographical features of the state.

259 ———— [Minnesota water resources.] U.S.G.S. Water supply papers. 114:226-32. map. 1912.

Discusses the topography of the state, the water-bearing strata, artesians basins, shallow wells and springs.

260 ———— Notable dike in the Minnesota River Valley.(Abstract). Am.Assoc.Adv.Sci. 39:263-64. 1890.

Explains "geologic relations, extent, mineralogic constituents and age."

261 ———— [Notes on the wells, springs and general water resources of Minnesota.] U.S.G.S. Water supply papers. 102:441-88. 1904.

262 ———— and **Sardeson,** F. W. Paleozoic formations of southeastern Minnesota. Geol.Soc.Am.Bull. 3:331-68. illus. map. Je.1892.
Abstract. Am.Geol. 10:182-83. S.1892.
Abstract. Am.Nat. 27:144. 1892.

"Describes the character of the Archean floor upon which the Upper Cambrian was deposited, and the lithological characters of the Magnesian series."

263 **Hall,** C. W. Red sandstone series of southeastern Minnesota. (Abstract). Science. n.s.27:722. My.8,1903.

264 **Hall,** C. W. Report. M.G.S.for 1879. 8:126-38. 1880.

The rocks of the north shore of Lake Superior are described.

265 ———— Sources of the constituents of Minnesota soils. Minn.Acad.Sci.Bull. 3:388-403. diagrs.tables. 1901.

266 ———— The structure, lithology and genesis of the magnesian series of the northwestern states.(Abstract.) Minn. Acad.Sci.Bull. 4:119-23. 1905.

267 ———— [Underground waters of Minnesota.] U.S.G.S. Water supply papers. 114:226-32. 1905.

"Describes the occurrence, character and water resources of water-bearing strata underlying the state."

Hall, C. W. *See also* Peckham, S. F. and Hall, C. W. 432.

268 **Hall,** James. Notes upon the geology of some portions of Minnesota, from St. Paul to the western part of the state. Am.Phil.Soc.Trans. n.s.13:329-40. 1869.

269 ———— On the geological structure of the southern part of Minnesota. Canadian Naturalist. n.s.3:120-21. D.1866.

270 ———— Preliminary notice of the fauna of the Potsdam sandstone, with remarks on the previous known species of fossils and description of some new ones from the sandstone of the upper Mississippi Valley. Albany Inst. Trans. 5: 93-195. 1867.

271 ———— and **Whitney,** J. D. Report on the geological survey of the state of Iowa, embracing the results of investigations made during portions of the years 1855, 1856, and 1857. Des Moines, 1858.

272 **Hall,** M. R., **Johnson,** Edward, and **Hoyt,** J. C. Mississippi River drainage basin. U.S.G.S. Water supply papers. 128:18-19. 1904.

273 **Hanchett,** A. H., and **Clark,** Thomas. Report of the state geologist. New York, 1864. 82p.

"Contains a short report of ten pages by Dr. Hanchett, and a valuable report by Mr. Clark on (1) The physical geography of the district embraced in that portion of the state bordering on Lake Superior. (2) A discussion of the meteorology of the district (3) A list of the leading plants and trees of the district."

274 **Hanna,** F. W., and **Hoyt,** J. C. Upper Mississippi River drainage. U.S.G.S. Water supply papers. 171:49-58. 1905.

275 **Hansell,** N. V. The concentration of iron ores. A.I.M.E. 44:37-68. illus. 1912.

Brief mention is made of the methods used on the Minnesota ranges.

276 **Harrington,** M. W. Geology of Dodge County. M.G.S. for 1875. 4:97-106. map. 1876; also M.G.S. Final report. 1:367-75. 1884.

277 **Harrington,** M. W. Geology of Olmstead County. M.G.S. for 1875. 4:75-96. map. 1876. also M.G.S. Final report. 1:325-46. 1884.

278 ———— Geology of Steele County. M.G.S. for 1875. 4:107-14. map. 1876. also M.G.S. Final Report. 1:394-403. 1884.

279 **Harrower,** H. D. Captain Glazier and his lake. Educational Reporter, Extra, O. 1886.

"An inquiry into the history and progress of exploration at the headwaters of the Mississippi since the discovery of Lake Itasca."

280 **Harvey,** W. H. Report of the inspector of mines of St. Louis County. 1st report, 1905-06, Minn. Bur. Labor. 10:453-76; 2d report, 1906-07, Minn.Bur.Labor. 11:170-95; 3d report, *See* Webb, F. J; 4th report, 1908-09, Minn.Bur. Labor. 12:628-37; 5th report, 1909-10, Minn. Bur. Labor. 12:638-55; 6th report, 1910-11, Minn. Bur. Labor. 13:378-99; 7th report, 1911-12, Minn. Bur. Labor. 13:400-11.

Tables show classification of labor, number of men employed, nationalities, wages; active mines, their locations, shipments, company operating and names of officials; number of accidents, fatal and non-fatal, and causes of accidents.

281 **Hayes,** C. W. Minnesota geological survey. U.S.G.S. Bulletin. 465:80-82. 1911.

Head, A. P., *See* Head, Jeremiah and Head, A. P. 282.

282 **Head,** Jeremiah and **Head,** A. P. Lake Superior iron ore mines, and their influence upon the production of iron and steel. Inst. Civil Eng. Proc. 137:72-102. diagrs. 1899.
Discussion of paper. ibid,pp.103-30.
Reprint. Colliery guardian. 78:445-48, 490-92, S.8,14, 1899.
Discussion and correspondence. ibid, pp.605-08,637-40. S.29,O.6, 1899.

Reports of geology and topography, mining methods, sampling and analysis of ores, transportation and valuation, and describes several typical mines.

283 **Herrick,** C. L., **Clarke,** E. S., and **Deming,** J. L. The Duluth gabbro. Am.Geol. 1:342-46. Je.1888.

Discusses the Duluth gabbro and garnetiferous gabbros from Granite Falls.

284 **Herrick,** C. L. Trenton limestone at Minneapolis. Am.Nat. 11:247-48. 1877.

285 **Hershey,** O. H. Archaeological notes on central Minnesota. Am.Geol. 24:283-94. N.1899.

Discusses the probable origin of the "implement bearing" quartz beds..

286 ———— Physiographic development of the upper Mississippi Valley. Am.Geol. 20:246-68 O.1897.

Description of the peneplains of southeastern Minnesota pp.247-53.

287 **Hewitt,** C. N. The water of artesian wells; its quality and the possibility of its becoming a source of supply in Minnesota. Minn.Acad.Sci.Bull. 3:125-27. 1889.

288 **Higgins,** Edwin. Fires in Lake Superior iron mines. U. S. Bureau of mines. Technical paper no. 59. illus. 1913. Abstract. Ir.Trd.Rev. 55:421-25. S.3,1914.

Gives chronological list of fires occurring in this district for the last 23 years. This paper "deals only with fires originating at or near the collar of the shaft, in the shaft, or underground."

289 ———— Safety in the mines of the Lake Superior iron ranges. L.S.M.I. 18:63-84. 1913.
Abstract. Min.Wld. 33:461-64. S.13,1913.
Abstract. Ir.Trd.Rev. 53:390-91,408-10. Ag.28, S.4, 1913.

Suggestions offered by the district engineer of the Michigan-Wisconsin-Minnesota division of the U. S. Bureau of mines.

290 **Hill,** A. J. How the Mississippi River and the Lake of the Woods became instrumental in the establishment of the northwestern boundary of the United States. Minn.Hist. Soc.Coll. 7:305-52. 1893.

291 **Hillebrand,** W. F. Feldspars from Minnesota gabbros. (Analyses) U.S.G.S. Bulletin. 78:122. 1891.

292 ———— and others. Rocks from Pigeon Point.(Analyses) U.S.G.S. Bulletin. 55:81-84. 1889.

293 **Hodge,** J. T. On the mineral region of Lake Superior. Am.Assoc.Adv.Sci. 2:301-08. 1850.

294 **Hodges,** LeRoy. Immigrant life in the ore region of northern Minnesota. Survey. 28:703-09. illus. S.7,1912.

Describes living conditions on the ranges, with statistics on wages and the various nationalities represented.

295 **Holmes,** W. H. Vestiges of early man in Minnesota. Am. Geol. 11:219-40. diagrs. Ap.1893.

An account of investigations made at Little Falls, in which he concludes that no proof of the presence of man has been discovered.

296 **Horton,** A. H., **Chandler,** E. F., and **Bolster,** R. H. Upper Mississippi River drainage. U.S.G.S. Water supply papers. 245:71-72. 1910.

297 ———— **Hoyt,** W. G. and **Jackson,** H. J. Hudson River drainage area in the U. S., Upper Mississippi River drainage basin. U.S.G.S. Water supply papers. 325:28-141. 1912.

Horton, A. H., *See also* Covert, C. C., Horton, A. H., and Hoyt, W. G. 100; Covert, C. C., Horton, A. H., and Bolster, R. H. 99, Follansbee, Robert, Horton, A. H., and Bolster, R. H. 178; Follansbee, Robert, Horton, A. H., and Jackson, H. J. 177; Follansbee, Robert, Horton, A. H., and Stevens, G. C. 179.

298 **Hoyt,** J. C. Crow Wing River drainage basin. U.S.G.S. Water supply papers. 99:14-17. 1904.

299 ———— Mississippi River near Sauk Rapids. U.S.G.S. Water supply papers. 98:173-74. 1904.

300 ———— Red Lake River at Crookston. U. S. G. S. Water supply papers. 100:491-94. 1904.

Hoyt, J. C. *See also* Babb, C. C. and Hoyt, J. C. 16; Hall, M. R., Johnson, Edward, and Hoyt, J. C. 272; Hanna, F. W. and Hoyt, J. C. 274.

Hoyt, W. G. *See* Covert, C. C., Horton, A. H., and Hoyt, W. G. 100; Horton, A. H., Hoyt, W. G., and Jackson, H. J. 297.

301 **Hulst,** N. P. Methods of mining iron ore in the Lake Superior region. Eng.Soc.West.Penn. 15:62-104. diagrs. 1899.
Describes typical mines to illustrate various methods.

302 ———— Moisture in Lake Superior ores. L.S.M.I. 8:21-32. 1902.
Reprint. Ir.Age. 70:20-21. Ag.28,1902.
Abstract. E. and M. J. 74:302. S.6,1902.
Discusses advisability of removing excess moisture before shipping

303 **Hunt,** T. S. Cambrian of North America. Am.Nat. 18: 409-11. Ap.1884.

304 ———— Note on the occurrence of glauconite in the Lower Silurian rocks. Am.Jour.Sci. 2d ser.33:277-78. 1862.
The glauconite was found in the Potsdam sandstone of the upper Mississippi Valley.

305 **Hurd,** Rukard. Hurd's iron ore manual. map. St. Paul, 1911. 162p.
A general reference, guide, hand book of the Lake Superior region, with values based on 1911 prices and guarantees at Lake Erie, method of determination of prices, premiums and penalties, tables of values and statistical data.

306 **Hurlbut,** W. D. Geology of southern Minnesota. Minnesota Teacher, 4:1-10,37-43,73-80,109-17,143-52. diagrs. Ja.-My. 1871.

I

307 **International mining manual.** 22d annual for 1914. Denver, 1914.
A directory of mines, giving rating, owner, superintendent, grade of ore mined, method of mining and number of men employed. Minnesota, pp.209-17.

308 **Irving,** R. D. Archean formations of the northwestern states. U.S.G.S. Annual report for 1883-84. 5:175-242. 1885.

Slate belt of St. Louis and Mississippi Rivers, pp.196-97, Quartzite series of southern Minnesota, pp.199-202.

Abstract. Am.Nat. 20:248-49. 1886.
Abstract. E.and M.J. 49:174-75. F.8,1890.

309 ———— Copper bearing rocks of Lake Superior. Am. Jour.Sci. 3d ser. 29:258-59. 1885.
Review by J. D. Dana. ibid,pp.67-68. 1885.
Review by N. H. Winchell, ibid,pp.339-40. 1885.

310 ———— Copper bearing rocks of Lake Superior. U.S.G.S. Monograph no. 5. illus.maps. 1883.
Abstract. Science. 5:299-300. 1883.

The Minnesota coast of Lake Superior is treated on pp.262-329; Snake and Kettle River district, pp.241-46; Mesabi Range, pp. 382-84.

311 ———— Copper bearing rocks of Lake Superior, U.S.G.S. Annual report for 1881-82. 3:89-188. maps. 1883.

Keweenawan rocks along the Minnesota coast named and described, pp.140-46.

312 ———— Is there a Huronian group? Am.Jour.Sci. 3d ser.34:204-16,249-63,365-74. diagrs. 1887.
Abstract. Am.Geol. 1:119-20. F.1888.

"Discusses the separability of a Huronian group from an underlying series." The Vermilion Lake region in Minnesota is studied.

313 ———— and **Van Hise,** C. R. On secondary enlargements of mineral fragments in certain rocks. U.S.G.S. Bulletin no.8 1884.

Slates of the St. Louis River Valley. Quartzite formation of southern Minnesota. Animikie series of northern Minnesota. Folded schists of the national boundary line.

314 **Irving.** R. D. On the classification of the early Cambrian and Pre-Cambrian formations. U.S.G.S. Annual report for 1885-86. 7:365-454. maps. 1888.
Abstract. Am.Geol. 4:111-12. Ag.1889.

Vermilion Lake region, pp.435-37. North shore of Lake Superior, pp.417-23.

315 ———— On the paramorphic origin of the horneblende of the crystalline rocks of the Northwestern states. Am.Jour. Sci. 3d ser.26:27-32,321-22; 27:130-34; 28:464. 1883-84.

316 ———— Origin of the driftless regions of the Northwest. Am.Jour.Sci. 3d ser.15:313-14. 1878.

317 ———— Origin of the ferruginous schists and iron ores of the Lake Superior region. Am.Jour.Sci. 3d ser. 32:255-72. 1886.
Abstract. Am.Nat. 20:1050-51. D.1886.
Abstract. Pop.Sci.Monthly. 33:714. S.1888.
Abstract. Sch.Mines Quar. 8:188. Ja.1887.

318 **Irving,** R. D. and **Van Hise,** C. R. The Penokee iron-bearing series of Michigan and Wisconsin. U.S.G.S. Monograph no. 19. illus. maps. 1892. also U.S.G.S. Annual report for 1889-90. 10:341-507. 1890.

The Animikie and Vermilion series of Minnesota are described.

319 **Irving,** R. D. Report on field work, 1884-85. U.S.G.S. Annual report for 1884-85. 6:40-48. 1885.

"Includes an account of observations on the Vermilion Lake, Animikie, and associated series."

320 ———— Report on studies of the Archean of the Northwest. U.S.G.S. Annual report for 1882-83. 4:28-34. 1884.

321 **Iverson,** S. G. Minnesota's land conservation policy. Minneapolis,1914. 29p.

Editorials taken from the Minneapolis Journal, Boston Herald, New York Evening Post, Chicago Inter-Ocean and other papers, on the administration of Minnesota school, University, swamp lands and mineral resources.

322 ———— Public lands and school fund of Minnesota. St.Paul.1911. 29p.

An address delivered before the Minnesota Historical Society, Feb.13,1911.

J

323 **Jackson,** C. T. Catlinite or Indian pipestone.(Analysis) Am.Jour.Sci. 35:388. 1839.

Jackson, H. J. *See*, Follansbee, Robert, Horton, A. H. and Jackson, H. J. 177; Horton, A. H., Hoyt, W. G., and Jackson, H. J. 297.

324 **Jagger,** T. A. Some conditions of ripple marks. Am.Geol. 13:199-201. Mr.1894.

Reviews paper by J. E. Spurr on "False bedding in stratified drift deposits."

James, Edward, compiler, *See* Long, S. H. 371.

325 **James,** J. F. The St. Peters sandstone. Cinn.Soc.Nat.Hist. 17:115-35. Jl.1894.

Reviews briefly the literature on the subject, discusses lithological characters, economic value and stratigraphic position.

326 **Jennings,** E. P. The Mesabi iron Range. Science. 23:73. F.9,1894.

Johnson, Edward, *See* Hall, M. R., Johnson, Edward and Hoyt, J. C. 272.

327 **Johnson,** J. A. Inaugural message to the Legislature of Minnesota, 1907. Minn.Ex.Docs.1905-06. v.1. 50p.

Discusses Taxation of iron mines; State versus private revenue from iron mines; Iron ore royalty tax; State department of mines, Mineral leases.

328 **Johnson,** J.A. Message of Governor Johnson accompanying his veto of the tonnage tax bill. Printed by the Commercial Club of Duluth, 1909. 32p.

Jones, J. T., *See* Winchell, H. V. and Jones, J. T. 658.

329 **Julien,** A. A. On the geological action of humus acids. Am. Assoc.Adv.Sci. 28:311-410. map. 1879.

K

Kaiser, W. J. *See* Martin, H. E. and Kaiser, W. J. 386.

330 **Keating,** W. H. Narrative of an expedition to the source of St. Peters River, Lake Winnepeek, Lake of the Woods, etc. Performed in the year 1823 . . . under the command of Stephen H. Long, U.S.T.E. 2v. London, 1825.
Abstract. Neues Jahrbuch. 1833:498-501. 1834.

331 **Kellogg,** L. O. Lake Superior iron ranges. E. and M.J. 97:83-86. map. Ja.10,1914.
Excerpt. Mineral industry. 22:283-388. 1913.

Reviews the progress made in 1913, especially as regards the treatment of ores.

332 ———— Notes on Mesabi Range mining practice. E.and M.J. 97:695-99,749-52. Ap.4,11,1914.

Notes on the various methods of mining on the Mesabi, and the equipment of the mines.

333 ———— Notes on the Cuyuna Range. E.and M.J. 96:1199-1203; 97:7-10. D.27,1913,Ja.3,1914.

Geology, methods of exploration and drilling, mining methods and equipment.

334 ———— Stockpiling on Minnesota and Michigan ranges. E.and M.J. 97:1035-38,1093-96. My.23,30,1914.

Describes several methods in use and compares their efficiency.

335 ———— Stripping with harbor dredge. E.and M.J. 97:500-02. illus. Mr.7,1914.

Details of an experiment to develop a method of stripping cheaper than the steam shovel, on the western Mesabi.

336 ———— Stripping with hydraulic giant. E.and M.J. 97:166-67. illus. Ja.17,1914.
Reprint. Eng.News. 71:293. F.5,1914.

Notes on stripping the Rowe mine Cuyuna Range.

337 **Kemp,** J. F. [Ore deposits of Vermilion and Mesabi districts.] In Ore deposits of the U.S. pp.144-54. New York, 1905.

338 **Kennedy,** F. A. Steel shaft sets on the Mesabi Range. E. and M.J. 89:206. illus. Ja.22,1910.
Reprint. E. and M.J. Handbook of mining details. pp.88-89. 1912.

339 **Kennedy,** Todd. Caving system in Chisholm district. E.and M.J. 94:775-76. illus. O.26,1912.

A criticism of L. D. Davenport's series of articles on "Caving system in Chisholm district".

340 ———— Caving system in the Ely district. Wis.Eng. 14:107-12. diagrs. F.1910.
Reprint. Min.Wld. 32:379-80. F.12,1910.

341 **Kennedy,** Patrick. Geology of the Minnesota River Valley. Minn.Acad.Sci.Bull. 3:309. 1901.

342 **Keyes,** C. R. Bibliography of North American paleontology, 1888-1892. U.S.G.S. Bulletin no.121. 1894.

Minnesota, pp.150-51.

343 **Keyes,** J. A. Falls of the Mississippi. Pop.Sci.Monthly· 31:474-77. Ag.1887.

"Describes some features of the geology of the region, and discusses the probable former position and extent of the falls."

Kimball, J. P. *See* Foster, J. W. and Kimball, J. P. 180.

344 **Kloos,** J. H. Cretaceous basin in the Sauk Valley. Am· Jour.Sci. 3d ser.3:17-26. Ja.1872.
Abstract. Minnesota Teacher. 5:113-18. 1872.

345 ———— Geognostische und geographische beobachtungen in Staate Minnesota. Zeit. Gesell.für Erdkunde Berlin. 12:266-320. 1877.
Translation by N. H. Winchell. M.G.S. for 1890. 19: 81-121. 1892.

"General description of drift deposits in the state, the Lower Silurian and Archean of the upper Mississippi, the Cretaceous and crystalline rocks of Sauk Valley, the Lower Silurian and Huronian melaphyre of the St. Croix Valley, the Upper Huronian slates of St. Louis River, and the Silurian melaphyre and gabbro of Lake Superior, with a résumé of results."

346 ———— Geological rambles in Minnesota. Minnesota Teacher. 4:181-26,217-23. Je.-Jl.1871.

347 ———— Geologische notizen aus Minnesota. Zeit Geol.Gesell. 23:417-48. map. 1871.
Translated by N. H. Winchell. M.G.S. for 1881. 10: 175-200. 1882.

"Original observations on the stratigraphic relations of the formations."

Kloos, J. H. *See also* Streng, A. and Kloos, J. H. 500.

L

348 **Lake Superior iron ore annual.** Official figures on shipments by mines, ranges, and ports, together with complete statistics bearing on the Lake Superior ore movement since 1844. Ore prices, receipts at lower Lake docks. Cleveland,1913.

Paging in index refers to Annual for 1913.

349 **Lane,** A. C. Comment on the "Report of the special committee on the Lake Superior region". Jour.Geol. 13: 457-61. Jl.-Ag.1905.

350 **Lauck,** W. J. Iron ore mines on the Mesabi and Vermilion Ranges. Min.Wld. 35:1269-70. tables. D.23,1911.

Gives a report on working conditions and labor supply, progress and efficiency of employees, reasons for employing immigrants, and tables showing racial classification.

351 **Laudig,** O. O. Action of blast-furnace gases upon various iron ores. A.I.M.E. 26:269-78. diagrs. tables. 1896. Discussion by F. E. Bachman and R. H. Sweetser. ibid,pp. 1061-71.

Ores from the Mesabi and Vermilion Ranges are included in these experiments, made in the laboratory of the Buffalo Furnace Company.

352 **Lawson,** A. C. The anorthosytes of the Minnesota coast of Lake Superior. The Laccolitic sills of the northwest coast of Lake Superior, with a prefatory note on the Norian of the northwest, by N. H. Winchell. Minneapolis,1893. (M.G.S.Bulletin no. 8.)
Abstract. Am.Nat. 27:898. 1893.
Abstract. Am.Geol. 12:59-60. Jl.1893.

353 ———— Sketch of the coastal topography of the north side of Lake Superior, with special reference to the abandoned strands of Lake Warren. M.G.S. for 1891. 20: 181-289. illus.maps. 1893.
Abstract. Am.Geol. 11:356-57. My.1893.

354 **League of Range School Superintendents.** Tonnage tax and the iron range. A protest against a destructive measure. 6p.

355 **Leith,** C. K. Comparison of the origin and development of the iron ores of the Missabe and Gogebic Ranges. L.S.M.I. 8:75-81. 1902.
Reprint. Ir.Age. 70:24-25. D.4,1902.

356 ———— Conserving Lake Superior ores. Ir.Trd.Rev. 54:479-80. Mr.5,1914.

357 ———— Genesis of Lake Superior ores. Econ.Geol. 1:47-66. illus. O.1905.

"A summary of conclusions presented in U. S. G. S. monographs, with a report of later work and a summary of the general geology of the ores and ore-bearing series."

358 ———— Geologic work in the Lake Superior iron district during 1902. U. S. G. S. Bulletin. 213:247-50. 1903.

The Mesabi and Vermilion districts are studied, and notes on the character and occurrence of the iron ores are given.

359 ———— Geology of the Cuyuna iron Range. Econ.Geol. 2:145-52. Mr.1907.

360 **Leith,** C.K. Geology of the Mesabi iron Range. E.and M.J. 73:277. F.22,1902.
Reprint. Science. n.s.15:351. F.28,1902.

"Abstract of a paper read before the Geological Society of Washington. Discusses the stratigraphic geology and the origin of the ores."

361 ———— Lake Superior iron region during 1903. U.S.G.S. Bulletin. 225:215-20. map. 1904.
Reprint. Min.Wld. 21:198-200. Ag.27,1904.

362 ———— Lake Superior type of iron ore deposits. In Types of ore deposits, ed. by H. F. Bain. pp.53-76. 1911.

Adapted from U. S. G. S. Monograph no.52.

363 ———— Mesabi iron-bearing district of Minnesota. U.S. G.S. Monograph no.43. 1903. 316p.33 plates.
Review. E.and M.J. 76:167-68. Ag.1,1903.
Review. Ir.Age. 70:25-27. O.23,1902.

"Describes geography and topography, gives a brief history of the opening and development of the district and reviews the literature bearing on the geology of the region. Describes the lithologic character, occurrence, structure, and geologic relations of Archean, Huronian, Keweenawan, Cretaceous, and Quaternary deposits and discusses the geologic history of the region, the correlation of the formations, the distribution, character and geologic occurrence of the iron ores, their petrographic relations to adjacent rocks and origin, and the development of the mining industry of the district."

364 ———— Summary of Lake Superior geology with special reference to recent studies of the iron-bearing series. A.I.M.E. 36:101-53. illus.map. 1906.
Abstract. Ore deposits, ed. by S. F. Emmons. pp.633-56. 1911.

365 ———— Use of geology in iron ore exploration. Econ. Geol. 7:662-75. O.-N.1912.

Brief mention is made of the work of geologists in limiting the field of probable deposits in Minnesota.

Leith, C. K. *See also* Van Hise, C. R. and Leith, C. K. 595; Van Hise, C. R., Leith, C. K., and Clements, J. M. 597.

366 **Lescohier,** D. D. Accidents and accident prevention in the Minnesota iron mines. Survey. 28:710-16. illus. S.7,1912.

Summarizes a special investigation of the accident prevention work of the Oliver Iron Mining Company.

367 ———— Iron mining. Minn.Bur.Labor. Biennial report for 1909-10. 12:198-245; also Biennial report for 1911-12. 13:101-16.

Tables giving nature of accidents received in the iron mines of Minnesota, the causes of accidents, relative hazard of different mine occupations, number of miners employed, nationality, and number of years residence in the U.S.

368 ———— Risks of the ore diggers. Survey. 26:514-20. Jl.1,1911.

369 **Lescohier,** D. D. Safety in a concentration plant. Survey. 28:773-78. illus. S.21,1912.

Describes the safety devices used in the ore washing plant of the Oliver Iron Mining Company, at Coleraine.

370 **Lesquereux,** Leo. Cretaceous fossil plants from Minnesota. M.G.S. Final report. 3:1:1-22. 1897.

"Gives a sketch of the geologic range of plant remains, and describes the plant remains of the Cretaceous of Minnesota."

370a **Leverett,** Frank. Surface formations and agricultural conditions of northwestern Minnesota . . . with a chapter on climatic conditions of Minnesota, by U. G. Pursell. illus.tables,maps. Minneapolis,1915. 78p. (M.G.S. Survey. Bulletin no.12.)

371 **Long,** S. H. Account of an expedition from Pittsburg to the Rocky Mountains, performed in the years 1819-20; compiled by Edward James. 2v.and atlas. Philadelphia,1823.

Brief mention of the Cambrian and Cretaceous in Minnesota.

372 ———— Voyage in a six-oared skiff to the falls of St. Anthony in 1817. Minn.Hist.Soc.Coll. 2:9-88.

Introductory note by E. D. Neill.

373 **Longyear,** E. J. Exploration on the Mesabi Range. A.I. M.E. 27:537-41. 1897.

Explains the mode of occurrence of the ores, and the methods used in exploration.

374 **Low,** V. F. S. Impressions gathered while traveling. Australian Mining Standard. 47:337-?. illus. Ap.11,1912. 1600 words. Not seen.

Includes notes on the Mesabi Range.

375 **Loye,** H. E. Opening of Leonidas mine at Eveleth. L.S. M.I. 18:192-210. illus. diagrs. 1913.

Special attention is directed to the shaft, which is of steel and concrete, and to the pumping stations.

Lutes, J. S. *See* Bayliss, Willard, McNeil, E. D., and Lutes, J. S. 38.

M

375a **McAuliffe,** P. J. Stripping a mine by hydraulic methods. Coal Age. 5:568-69. illus. Ap.4,1914.

Describes the stripping methods used on the Rowe mine.

376 **McClure,** W. F. Steel trust on the Great Lakes. R.of Rs. 23:560-66. illus.maps. My.1901.

377 **Macco,** Albrecht. Bericht über studienreise nach den Vereinigten Staaten von Nordamerika. map.diagrs. Stahl und Eisen. 1904:69-81,144-55. Ja.15,F.1,1904.

Notes on a visit to the Minnesota ore deposits, and the furnaces of Pennsylvania.

378 **Macco,** Albrecht Eisenerzlagerstätten am Lake Superior. Zeit. für Prak.Geol. 12:48-53,377-99. maps. F.,N.1904.

The geology of the iron ore deposits, their occurrence and character.

378a **McDonald,** P. B. Interesting facts about the Mesabi. Ir. Trd.Rev. 57:190. Jl.22,1915.

378b ———— Lake Superior iron ranges. Can.Min.Jour. 36:437-38. Jl.15,1915.

Contents: Variety of methods.—Administration.—Miners.—Exploration phase.—U. S. Steel Co. interests.—No monopoly.—Six principal ore ranges.

379 ———— Shaft timbering, Mesabi Range. M. and S. P. 109:690. O.31,1914.

380 ———— Sinking through sand in the Lake Superior ranges. M. and S. P. 108:1047-48. Je.27,1914.

381 **Macfarlane,** James. American geological railway guide, giving the geological formations at every railway station, with altitudes above mean tide water, notes on interesting places on the routes and a description of each formation. 2d ed. New York,1890.

Notes for Minnesota, pp.246-52, prepared by N. H. Winchell.

382 **McKellar,** Peter. Correlation of the Animikie and Huronian rocks of Lake Superior. Royal Soc. of Canada. 1st ser.,pp.63-73. 1888.

McNeil, E. D. *See* Bayliss, Williard, McNeil, E.D., and Lutes, J.S. 38.

383 **McVey,** F. L. Taxation of mineral properties. In International Tax Association. State and local taxation, Toronto,1909. pp.411-30.

384 **Marshall,** R. B. Results of spirit-leveling in Minnesota. U.S.G.S. Bulletin no.453,560. 1911,1914.

Covers the work done in Minnesota from 1897-1910, 1897-1912.

385 ———— Results of triangulation and primary traverse in Minnesota. U.S.G.S. Bulletin. 440:336-44; 496:164-205; 551:212-39. 1910-14.

Results of work in 1906-08, 1909-10, 1911-12.

386 **Martin,** H. E., and **Kaiser,** W. J. Application of mining machines to underground mining on the Mesabi Range. L.S.M.I. 18:187-91. illus. 1913.
Reprint. Ir.Trd.Rev. 53:537-38. S.25,1913.
Reprint. Min.Wld. 39:602. O.4,1913.

387 **Mason,** A. J. Movement of iron ore on the Great Lakes. West.Soc.Eng. 9:109-21. illus. Ap.1904.

387a **Mathesius,** Walther. High blast heats in Mesabi practice. A.I.M.E. Bulletin. 99:539-55. tables. Mr.1915
Abstract. Ir.Age. 95:475-78. F.25,1915.
Abstract. Ir.Trd.Rev. 56:365-68. F.18,1915.
Discussion. A.I.M.E. Bulletin. 101:1100-07. My. 1915.

Contents: Stove construction. Stove operation. Heat calculation.

388 **Mead,** D. W. The hydro-geology of the upper Mississippi Valley and of some of the adjoining territory. Assoc.Eng. Soc.Jour. 13:329-96. diagrs.maps. Jl.1894.

Tables show amount of annual rainfall and rate of evaporation, data on artesian and deep wells, and gives a general summary of the geology of the region, and the length, drainage area, and discharge of the upper Mississippi River.

389 **Meeds,** A. D. New locality for cobalt in Minnesota.(Abstract) Minn.Acad.Sci.Bull. 4:18. 1906.

390 ———— The Stillwater, Minnesota, deep well. Am.Geol. 3:341-42. My.1889.
Reprint. Science. 13:401. My.24,1889.
Reprint. Minn.Acad.Sci.Bull. 3:274. 1891.

"Gives a brief description of the rocks penetrated by the well the section shown by the well record, and the microscopic characters of a diabase porphrite occurring at a depth of 3,300 feet."

391 **Meeks,** Reginald. Iron ore mines of the Mesabi Range. E.and M.J. 84:194-95. illus. Ag.3,1907.

An illustrated account of mines opened in 1892, which now produce 62 per cent of the ore from the northern ranges.

Meinzer, O. E., *See* Hall, C. W., Meinzer, O. E. and Fuller, M. L. 249.

392 **Merrill,** G. P. Building and ornamental stones [of Minnesota]. Smithsonian Institution Reports. 1886:2:400-02,421-22, 451-52,467-68,556-58. 1889.

393 ———— Microscopic structure of the building stones of [Minnesota.] U.S.Census office, 10th census, 1880. 10: 244-56. 1884.

394 ———— Stones for building and decoration. 3d ed. New York,1903.

Minnesota granites and gneisses, pp.72-73; Sandstones and conglomerates, pp.145-46; Slates p.187; Limestone and dolomites, pp.310-13.

395 **Merrill,** P. C. Top-set slicing, Mesabi Range. E.and M.J. 95:950. illus. My.10,1913.

396 **Miller,** S. A. Observations on the unification of geological nomenclature, with special reference to the Silurian formation of North America. Cinn.Soc.Nat.Hist. 4:267-93. 1881.

397 **Miller,** S.A. The Taconic system as established by Emmons, and the law of nomenclature applicable to the subject. Am.Geol. 1:235-45. Ap.1888.

Scattered references to Minnesota.

398 **Minnesota Bureau of Labor.** Biennial report, 1st-13th. St. Paul,1888-1912.

v.2,7-13 contain statistics as to tonnage, methods of mining labor, wages, accidents and descriptions of several mines. v.10 gives the text of the law providing for county mine inspection.

399 **Minnesota. Geological and natural history survey.** Bulletin. no.1-10. illus.maps. St. Paul,1887-1894. 10v.

Contents: no.1. The history of geological surveys in Minnesota by N. H. Winchell. 1889.—no.2.Preliminary description of the peridotytes, gabbros, diabases, and andesytes of Minnesota, by M. E. Wadsworth. 1887.—no.3.Report on botanical work in Minnesota for the year 1886, by J. C. Arthur. 1887.-no.4. Synopsis of the Aphididae of Minnesota, by O. W. Oestlund. 1887.-no.5. Natural gas in Minnesota, by N. H. Winchell. 1889.—no.6. Iron ores of Minnesota, by N. H. Winchell and H. V. Winchell. 1891.—no.7. The mammals of Minnesota; a scientific and popular account of their features and habits by C. L. Herrick. 1892.no.—8.(1)The anorthosytes of the Minnesota coast of Lake Superior. (2)The laccolitic sills of the northwest coast of Lake Superior, by A. C. Lawson. 1893.no.—9. Minnesota botanical studies, v. 1, ed.by Conway MacMillan. 1898.—no.10. The iron-bearing rocks of the Mesabi Range in Minnesota, by J. E. Spurr. 1894.

400 ———— First-twenty-fourth annual report for the year 1872-1898. illus.maps. St. Paul,1873-1899. 24v.

401 ———— The geology of Minnesota. Final report. v.1-6. St.Paul,1884-1901. 6v.in 7.

Contents

Vol. 1. 1872-1882. Historical sketch of explorations and surveys in Minnesota; The general physical features of Minnesota; The building-stones of Minnesota; The geology of Houston, Winona and Fillmore counties; by N. H. Winchell.—The geology of Olmstead County, by M. W. Harrington.—The geology of Mower County, by N. H. Winchell.—The geology of Dodge County, by M. W. Harrington.—The geology of Freeborn County, by N. H. Winchell.—The geology of Steele County, by M. W. Harrington.—The geology of Waseca, Blue Earth, Faribault, Watonwan, Martin, Cottonwood, Jackson, Murray and Nobles counties, by W. Upham.—The geology of Pipestone and Rock counties, by N. H. Winchell.—The geology of Brown, Redwood, Yellow Medicine, Lyon, Lincoln, Big Stone, Lac qui Parle and Le Sueur counties, by W. Upham.—The geology of Rice County, by N. H. Winchell.

Vol. II. 1882-1885. The geology of Wabasha, Goodhue and Dakota counties, by N. H. Winchell.—The geology of Carver, Scott, Sibley, Nicollet, McLeod, Renville, Swift, Chippewa, Kandiyohi, Meeker and Wright counties, by W. Upham.—The geology of Hennepin, Ramsey and Washington counties, by N. H. Winchell.—The geology of Chisago, Isanti, Anoka, Benton, Sherburne, Stearns, Douglas, Pope, Grant, Stevens, Wilkin, Traverse, Otter Tail, Wadena, Todd, Crow Wing, Morrison, Mille Lacs, Kanabec, Pine, Becker and Clay counties, by W. Upham.

Vol. III. pt, I. 1885-1892. Paleontology: Historical sketch of investigation of Lower Silurian in the upper Mississippi Valley, by N.H. Winchell and E. O. Ulrich.—Cretaceous fossil plants from Minne-

Minnesota. Geological and natural history survey. The geology of Minnesota. (Contents, continued)

sota by L. Lesquereux.—The microscopical fauna of the Cretaceous in Minnesota, with additions from Nebraska and Illinois, by A. Woodward and B. W. Thomas.—Note on other Cretaceous fossils in Minnesota, by N. H. Winchell.—Sponges, graptolites and corals from the Lower Silurian in Minnesota, by N. H. Winchell and C. Schuchert.—On Lower Silurian *Bryozoa* of Minnesota, by E. O. Ulrich.—The Lower Siluria *Brachiopoda* of Minnesota, by N. H. Winchell and C. Schuchert.

Vol. III, pt. II. 1892-1896. Paleontology: The Lower Silurian deposits of the upper Mississippi province; a correlation of the strata with those in the Cincinnati, Tennessee, New York and Canadian provinces, and the stratigraphic and geographic distribution of the fossils, by N. H. Winchell and E. O. Ulrich.—The Lower Silurian *Lamellibranchiata* of Minnesota; The Lower Silurian *Ostracoda* of Minnesota; by E. O. Ulrich.—The Lower Silurian trilobites of Minnesota; The Lower Silurian *Cephalopoda* of Minnesota;by J. M. Clarke.—The Lower Silurian *Gastropoda* of Minnesota, by E. O. Ulrich and W. H. Scofield.

Vol. IV. 1896-1898. The geology of Carlton County, by N. H. Winchell.—The Geology of Aitkin County; The geology of Cass County and of the part of Crow Wing County northwest of the Mississippi River; by W. Upham.—The geology of Hubbard County and northwestern portion of Cass County; The geology of Norman, Polk, Marshall, Roseau, Kittson and Beltrami counties; by J. E. Todd.—The geology of Itasca County, by U. S. Grant.—The geology of the southern portion of St. Louis County; The geology of the northern part of St. Louis County; The geology of Lake County; by N. H. Winchell.—The geology of Cook County; The geology of Pokegama Lake, Grand Rapids, and Swan Lake plates; by U. S. Grant.—The geology of Hibbing, Mountain Iron, Virginia, Partridge River and Dunka River plates of the Mesabi iron range; by N. H. Winchell.—The geology of the Gabbro Lake, Snowbank Lake, Fraser Lake, Akeley Lake, Gunflint Lake, Rove Lake, Mountain Lake plates, by U. S. Grant.—The geology of the Pigeon Point, Vermilion Lake, Carlton and Duluth plates, by N. H. Winchell.—Minnesota iron mining economically and statistically considered, by H. V. Winchell.

Vol. V. 1898-1900. Structural and petrographic geology of the Taconic and Archean: Structural geology, by N. H. Winchell.—Petrographic geology of the crystalline rocks of Minnesota, by N. H. Winchell and U. S. Grant.—Petrographic geology and descriptions.—Mineralogy and petrology of Minnesota, by N. H. Winchell.—Appendix, by N. H. Winchell: The structure of the Keweenawan: Additional rock descriptions.

Vol. VI. 1900-1901. Geological atlas with synoptical descriptions, by N. H. Winchell.

402 **Minnesota. Geological survey.** Bulletin no.11-12. Minneapolis,1914-1915.

Contents: no.11. Preliminary report on the clays and shales of Minnesota, by F. F. Grout and E. K. Soper. 1914.—no. 12 Surface formations and agricultural conditions of northwestern Minnesota, by Frank Leverett, with a chapter on climatic conditions of Minnesota, by U. G. Purssell. 1915.

403 **Minnesota Historical Society.** Collections. v.1-16. St. Paul,1872-1913.

Contains valuable material on the early explorers and exploration.

404 **Minnesota. School of Mines.** Experiment station. Bulletin no.1-4. Minneapolis,1912-15. 4v.

Contents: no. 1. Iron mining in Minnesota, by C.E. van Barneveld. 1912—no.2. Preliminary concentration tests on Mesabi ores, by W. R. Appleby and Edmund Newton. 1913.—no3. Preliminary concentration tests on Cuyuna ores, by W. R. Appleby and Edmund Newton. 1915.—no.4. Bibliography of Minnesota mining and geology, by Winifred Gregory. 1915.

Maps of the mining districts of Minnesota, by E. H. Comstock. 1914.

405 **Minnesota. Tax Commission.** Biennial report 1st-4th. St. Paul,1908-14. 4v.

Taxation of iron ore lands 1:110-48—Mines and minerals. 2:49-89; 3:58-100 4:75-152.

Contains notes on geology, prospecting and methods of mining, ore estimates, mine valuation, iron reserves, taxation, transportation and the work of the School of Mines.

406 **Minnesota. State Drainage Commission.** Biennial report 1st-2d. St. Paul,1910-1913. 3v.

Contains the results of topographic surveys during the years 1909-10 and 1909-12.

407 ———— Report of the water resources investigation of Minnesota. St. Paul,1910-12. 3v.and atlas of 98 sheets.

The investigations were carried on during 1909-10 and 1911-12.

408 ———— Report on drainage work in Minnesota. St. Paul,1913.

This report covers the years 1907-12.

409 ———— Report on topographical and drainage survey of swamp and marshy lands owned by the state of Minnesota. Crookston,1906.

410 **Morrison,** William. Who discovered Itasca Lake. Minn. Hist.Soc.Coll. 1:417-19. 1856.

410a **Murphy,** J. F. Automatic signal system used in stockpiling iron ore. E. and M. J. 100:225. diagr. Ag.7,1915.

411 **Murray,** C. B. Need of uniform methods of sampling Lake Superior iron ore. A.I.M.E. Bulletin 85:135-41 Ja. 1914.

Discussion of this paper. A.I.M.E. Bulletin. 90:1269-88. Je.1914.

Describes the method used by the U. S. steel corporation, and adopted by several mines on the ranges. Contains also suggestions for sampling car loads.

Murray, *See* Crowell and Murray. 103.

412 **Mussey,** H. R. Combination in the mining industry. A study of concentration in Lake Superior ore production. New York,1905. 169p.

N

Narraway, J. E. *See* Raymond, P. E. and Narraway, J. E. 440.

413 **Neill,** E. D. History of Minnesota, from the earliest French explorations to the present time. illus. Minneapolis, 1878. 777p.

Contains much information on the early explorations of Minnesota.

414 **Nelson,** N. P. The formation of a terrace. Am.Geol. 12:125-26. Ag.1893.

A beach ridge in Ottertail County is described.

415 **Newell,** F. H. Hydrography of the Mississippi River in Minnesota. U.S.G.S. Annual report for 1897-98. 19:4:264-70; also Annual report for 1898-99. 20:4:227-31; and Annual report for 1900-01. 22:4:210-19.

Maps show lakes and reservoirs at the head of the Mississippi.

416 ———— Measurement of flow of the Mississippi River. U.S.G.S. Water supply papers. 36:194. 1899; also 49:260. 1900.

417 ———— Measurement of flow of the Red River and Red Lake River. U.S.G.S. Water supply papers. 66:9-11. 1901.

418 ———— Red Lake River at Crookston. U.S.G.S. Water supply papers. 85:234-35. 1903.

Newton, Edmund. *See* Appleby, W. R. and Newton, Edmund. 12, 12a.

419 **Nicollet,** J. N. Remarks on the geology of the region of the upper Mississippi and Cretaceous formations of the upper Missouri. Am.Jour.Sci. 1st ser.41:180-82. 1841.
Reprint. Assoc.Am.Geol.Trans. 1843:32-34. 1843.

420 ———— Report intended to illustrate a map of the hydrographical basin of the upper Mississippi River, made . . . while in employ under the Bureau of the corps of topographical engineers. 26th Congress, 2d session, S.E. Doc.no.237, series no.380.

"The rocks at Pokegama Falls are briefly described and Missabay Heights are indicated on the map for the first time by Hachures."

421 **Norwood,** J. G. Description of the geology of middle and western Minnesota. In Report of a geological survey of Wisconsin, Iowa and Minnesota, by D. D. Owen. pp.213-418. 1852.

"Dr. Norwood crossed the Mesabi Range in two places... and reports the occurrence of iron-formation material at Gunflint Lake."

422 **Nuttall,** Thomas. Observations on the geological structure of the valley of the Mississippi. Phil.Acad.Sci.Jour. 2:1:14-52. 1821.

Narrative of a trip down the Mississippi in the summer of 1809. Quotes Carver and Long.

O

423 **Owen,** D. D. Abstract of an introduction to the final report on the geological surveys made in Wisconsin, Iowa and Minnesota, in the years 1847-1850, containing synopsis of the geological features of the country. Am.Assoc.Adv. Sci. 5:119-31. 1851.

424 ———— On a geological map of Wisconsin, Iowa and Minnesota. Phil.Acad.Sci.Proc. 6:189-91. 1854. Not seen.

425 ———— On the paleontology of the lowest sandstones of the Northwest. Am.Assoc.Adv.Sci. 5:169-72. 1851.

Discovery made in 1847 at the place now known as Stillwater.

426 ———— Report of a geological reconnaissance of the Chippewa land district of Wisconsin, and incidentally of a portion of the Kickapoo country, and of a part of Iowa and of the Minnesota Territory. 30th Congress, 1st Session, S.E.Doc.no.57. 1848.

427 ———— Report of a geological survey of Wisconsin, Iowa and Minnesota, and incidentally of a portion of Nebraska Territory. Philadelphia,1852. maps. plates. Contains Dr. J. G. Norwood's report.
Abstract by L. Turnbull. Franklin Inst.Jour. 3d ser. 27:131-33,182-86,268-70,347-49. 1854.
Extract. Am.Jour.Sci. 2d ser.15:296-99. 1853.
Extract. Am.Jour.Sci. 2d ser.16:86-95. 1853.

Owen, D. D. *See also* Shumard, B.F. and Owen, D. D. 478.

428 **Owen,** Richard. Report on Pigeon Point. In Report of a geological survey of Wisconsin, Iowa and Minnesota, by D. D. Owen. pp.397-400. 1852.

P

429 **Parker,** R. A. Iron ore region of Lake Superior. Eng.Mag. 6:152-76,185-303. N.-D.1893.

An illustrated article on the whole Lake Superior region. Special mention is made of the Vermilion Range on pp.288-90, and of the Mesabi Range on pp.290-303.

430 **Peale,** A. C. [Mineral spring resorts in Minnesota.] U.S.G.S. Annual report for 1892-93. 14:2:84. 1893.

431 ———— [Minnesota mineral springs.] U.S.G.S. Bulletin. 32:158-59. 1886.

432 **Peckham,** S. F. and **Hall,** C. W. On Lintonite and other forms of Thomsonite. A preliminary notice of the zeolites of the vicinity of Grand Marais, Minn. Am.Jour.Sci 3d ser.19:122-30. F.1880.
Reprint. M.G.S. for 1879. 8:166-72. 1880.

433 **Peckham,** S. F. Peat for domestic fuel. Minneapolis,1874.

434 **Piez,** Charles. Handling and storing of iron ore. Phil.Eng. Club.Proc. 20:177-86. 1903.

435 **Pike,** Z. M. An account of expeditions to the sources of the Mississippi, and through the western part of Louisiana, performed by order of the government of the U. S., during the years 1805, 1806, and 1807. Philadelphia, 1910. Extracts from his journals relating to explorations in Minnesota, Minn.Hist.Soc.Coll. 1:368-416. 1872.

436 **Pope,** John. Report of an exploration of the Territory of Minnesota. 31st Congress, 1st Session, S.E.Doc.no.42. map. 1854.

437 **Powell,** J. W. Artesian wells of the Red River Valley. U.S.G.S Annual report for 1889-90. 11:267-68. 1891.

437a **Pringle,** L. B. Grade-board for steam shovel use. E. and M. J. 99:572. diagr. Mr.27,1915.

438 ———— "Missed holes" in open-pit mining on the Mesabi Range. Min.Wld. 39:548. S.27,1913.

438a ———— Steam-shovel block. E. and M. J. 99:236. diagr. Ja.30,1915.

Gives construction of a block-and-clamp device used on the Mesabi Range.

Purssell, U. G. *See* Leverett, Frank, 370a.

R

439 **Ramquist,** P. L. Report of the inspector of mines of Itasca County. 1st report, 1909-10, Minn.Bur.Labor. 12:656-59; 2d report, 1910-11, Minn.Bur.Labor, 13:412-19; 3rd report, 1911-12, Minn.Bur.Labor.13:420-26..

Tables showing number of men employed, wages, active mines, company operating, accidents, shipments and other related subjects.

440 **Raymond,** P. E. and **Narraway,** J. E. Notes on Ordovician trilobites.pt.3. Asaphidae from the Lowville and Black River. Carnegie Museum Annals. 7:46-59. illus. N. 1910.

441 **Reagan,** A. B. Effect of ice in the lake upon the shore line. Ind.Acad.Sci.Proc. 1910:119. 1911.

442 ———— Mining in St. Louis and Koochiching counties, Minnesota. Min.Wld. 36:1150. Je.1,1912.

An account of gold and iron in new locations.

443 **Rice,** H. H. Mineral regions of Lake Superior. Minn. Hist.Soc.Coll. 2:175-82. 1867.

A history of mining in the Lake Superior region from the discovery of ore to 1865.

444 **Richards,** F. B. Furnace practice with Mesabi ores. Ir.Trd. Rev. 29:17. Ja.2,1896.

Discusses the physical properties of the ores on the ranges.

445 **Ries,** Heinrich. [Clays of Minnesota.] In Clays, their occurrence, properties and uses. pp.348-51. 1906.

446 ———— and **Leighton,** Henry. [Minnesota clay products] In History of the clay-working industry in the U. S. pp.115-18. 1909.

Table gives value of clay products of Minnesota from 1894-1907.

447 **Ries,** Heinrich. [Minnesota iron ores.] In Economic geology, with special reference to the U. S. pp.368-71. 1911.

448 **Roherty,** J. N. Trout Lake concentrating mill. Wis.Eng. 14:261-65. Je.1910.

Excerpt. Eng.News. 68:449. S.5,1912.

449 **Rotthaus,** J. E. Magnetic surveying on the Cuyuna. E.and M.J. 98:603-04. O.3,1914.

450 **Ruggles,** W. B. How economics are effected by drying ore. Ir.Trd.Rev. 54:209-10. Ja.22,1914.

Describes the operation of the dryers installed at the Brunt mines, Mountain Iron, Minnesota.

S

451 **Salisbury,** R. D. On the northward and eastward extension of the pre-Pleistocene gravels of the Mississippi basin. (Abstract). Geol.Soc.Am.Bull. 3:183-86. Mr.31,1892.

A review of articles written on this subject, and gives results of recent observations.

452 ———— Pre-Glacial gravels on the quartzite range near Baraboo, Wis. Jour.Geol. 3:635-67. S.1895.

"Discusses the evidence as to the age of these gravels and their relation to the high-level gravels of adjacent states."

Salisbury, R. D. *See also* Chamberlin, T. C. and Salisbury, R. D. 82.

453 **Sardeson,** F. W. Beginning and recession of Saint Anthony Falls. Geol.Soc.Am.Bull. 19:29-52. maps. Mr.30, 1908.

Abstract. Science. n.s.27:729. My.1908.

"Describes terraces and other evidences of drainage changes in the vicinity of St. Paul and Minneapolis, and discusses the rate of recession of the Falls, and factors by which the rate was determined."

454 ———— Characteristics of the glacial drift sheets in Minnesota.(Abstract). Science. n.s.33:467. Mr.24,1911.

455 ———— The fauna of the magnesian series. Minn. Acad.Sci.Bull. 4:92-105. plates. F.28,1896.

456 **Sardeson,** F. W. Folding of subjacent strata by glacial action. Jour.Geol. 14:226-32. diagrs. Ap.1906.

The examples used to illustrate are all taken from Minnesota.

457 ———— Fossils in the St. Peter sandstone. Minn.Acad. Sci.Bull. 3:318-19. 1901.

458 ———— Galena series. Geol.Soc.Am.Bull. 18:179-94. diagrs. My.15,1907.
Abstract. Science. n.s.25:771. My.17,1907.

"Discusses the distribution, relations, and nomenclature of Ordovician formations of the upper Mississippi Valley included in the Galena series."

459 ———— Geological history of the Redstone quartzite. Geol.Soc.Am.Bull. 19:221-42. maps. S.21,1908.

460 ———— Intraformational conglomerates in the Galena series. Am.Geol. 22:315-23. N.1898.

461 ———— The Lower Silurian formations of Wisconsin and Minnesota compared. Minn.Acad.Sci.Bull. 3:319-26. 1901.

462 ———— A new cystocrinoidean species from the Ordovician. Am.Geol. 24:263-76. N.1899.

"Discusses the relationship of the Crinoidea and Cystoidea."

463 ———— Paleozoic fossils in the drift. Minn.Acad.Sci. Bull. 3:317-18. 1901.

464 ———— A particular case of glacial erosion. Jour. Geol. 13:351-57. My.1905.

Illustration taken from the east side of the Mississippi gorge, about a mile below the falls of St. Anthony.

465 ———— Range and distribution of the Lower Silurian fauna of Minnesota. Minn. Acad. Sci. Bull. 3:326-43. 1901.

Describes several new species.

466 ———— Report of the Secretary of the Geological club of the University of Minnesota. Science. 9:412-13. Mr.17,1899.

The report contains quotations from Prof. C. W. Hall's paper on "The extent and distribution of the Archean in Minnesota."

467 ———— The St. Peter sandstone. Minn.Acad.Sci.Bull. 4:64-88. illus. 1906.

The fauna of the St. Peter sandstone is described, and the geographic distribution and the lithologic characters are given.

468 ———— The so called Cretaceous deposits in southeastern Minnesota. Jour.Geol. 6:679-91. O.1898.

Sardeson, F. W. *See also* Hall, C. W. and Sardeson, F. W. 243, 255, 262.

469 **Sawhill,** R. V. Independents show power despite record Corporation ore shipments. Ir.Trd.Rev. 54:498-501. Mr.12,1914.

Details of 1913 ore movement from the Lake Superior ranges.

469a **Scallon,** E. P. Draining watercourses in chutes. E. and M. J. 99:573. diagrs. Mr.27,1915.

Gives form of chute construction used in the Lincoln mine, Virginia, Minn.

470 **Schoolcraft,** H. R. Memoir on the history and physical geography of Minnesota. Minn.Hist.Soc.Coll. 1:108-31. 1876.

471 ———— Narrative journal of travels through the northwestern regions of the United States, extending from Detroit through the great chain of American lakes to the sources of the Mississippi River. map. Albany, 1821. 419p.

472 ———— Narrative of an expedition through the upper Mississippi to Itasca Lake, the actual source of this river. map. New York,1834. 301p.

473 ———— Summary narrative of an exploratory expedition to the sources of the Mississippi in 1820, resumed and completed by the discovery of its origin in Itasca Lake in 1832. Philadelphia, 1854.

Schoolcraft, H. R. *See also* Allen, James and Schoolcraft. H. R. 9.

474 **Schuchert,** Charles. On the development of the skull of Zygospira recurcirostra. Wash.Biol.Soc. 8:79-82. 1893.

"Describes specimens obtained from Minnesota from a horizon equivalent to the Trenton of New York and gives a statement of observations and correlations."

Schuchert, Charles. *See also* Winchell, N. H. and Schuchert, Charles, 762, 788, 813.

Scofield, W. H. *See* Ulrich, E. O. and Scofield, W. H. 535.

475 **Sebenius,** J. U. Wash ores of western Missabe Range and the Coleraine concentrating plant. L.S.M.I. 18:155-86. illus.map. 1913.
Excerpt. Ir.Age. 92:452-55. illus.plans. Ag.28,1913.

Contents: Geology. Structure. Mining method. Main points bearing upon the commercial utilization of the western Missabe silicious ore deposits. Concentration of the western Missabe silicious ores. Trout Lake concentrating plant. Process of concentration. Safety devices. Production.

476 **Shimek,** B. Loess and its fossils. Iowa.Lab.Nat.Hist. 1:200-14; 2:89-98. 1890.
Abstract. Am.Jour.Sci. 3d ser. 4:72. 1891.

477 **Shumard,** B. F. Geological Report of local, detailed observations in the valleys of the Minnesota, Mississippi, and Wisconsin Rivers. In Report of a geological survey of Wisconsin, Iowa and Minnesota, by D. D. Owen. pp.475-531. 1852.

478 **Shumard,** B.F. and **Owen,** D. D. On the number and distribution of fossil species in the Paleozoic rocks of Iowa, Wisconsin and Minnesota. Am.Assoc.Adv.Sci. 5:235-39. 1851.

The total number of species embraced between the Carboniferous and the oldest sandstones of the Silurian is given as 320, included in 102 genera.

479 **Sill,** R. T. Underground mining on the Mesabi iron Range. Min.Wld. 25:663. D.1,1906.

A brief description of mining methods, and a discussion of costs.

480 **Singewald,** J. T. Titaniferous iron ores in the U. S. Their composition and economic value. U.S.Bureau of mines. Bulletin no.64. 1913.

Minnesota ores are discussed on pp.93-110. This report points out methods of utilizing these ores.

481 **Smart,** George. Rules for adjusting premiums and penalties on Lake Superior iron ores. Ir.Trd.Rev. 48:495-98. Mr.9,1911.

482 **Smith,** H. L. List of species and some notes upon them. M.G.S.for 1891. 20:293-306. 1893.

"Contains notice of the discovery of a peat deposit of Minnesota carrying fresh-water forms, which occur between layers of bowlder clay, and contain a marine fauna. Gives a list of diatoms found in the peat, with notes on the species.

483 **Smith,** H. W. Preliminary notes on the conglomerates and amygdaloids of the Snake River valley. (Abstract). Minn. Acad.Sci.Bull. 3:312-13. 1901.

484 **Smock,** J. C. Ores, minerals and mineral substances of industrial importance [in Minnesota.] U.S.G.S. Mineral resources, 1882:697-98; 1887:747-48.

Gives location of the occurrence of the useful minerals.

485 **Smyth,** H. L. and **Finlay,** J. R. Geological structure of the western part of the Vermilion Range. A.I.M.E. 25:595-645. illus.diagrs. 1895.

485a **Soper,** E. K. Buried rock surface and pre-glacial river valleys of Minneapolis and vicinity. Jour.Geol. 23:444-60.

Contents: Introduction and summary.—Rock formations beneath the drift.—The surface of the buried rock.—Relations of buried rock surface to existing drift surface.—The buried river channels.—The drift.—Influence of buried river channels upon building construction.

486 ———— Iron mining in Minnesota. M. and S. P. 101:767-69. illus. D.10,1910.

487 ———— Iron ranges of Minnesota. E.and M.J. 91:766-70. illus. map. Ap.15,1911.

488 ———— New plant for washing iron ore, Mesabi Range. E.and M.J. 90:712-14. diagrs.map. O.8,1910.

Plans and description of the Oliver washery at Coleraine, in which log-washers and Overstrom tables are used.

489 **Soper,** E. K. Washing the sandy ores of the western Mesabi. Ir.Trd.Rev. 48:189-92. illus.flow-sheet. Ja.19,1911.

Description of the Trout Lake concentrating plant.

Soper, E. K. *See also* Grout, F. F. and Soper, E. K. 235.

490 **Spencer,** J. W. The ancient Mississippi and its tributaries. Kansas City Rev. 6:615-21. 1883. (Not seen.)

491 **Sperry,** L. B. Report on the geology of Rice County. M.G.S. for 1877. 6:114-25. map. 1878.

492 **Spurr,** J. E. False bedding in stratified drift deposits. Am. Geol. 13:43-47,201-06. Ja.,Mr.1894.

Review by T. A. Jagger, jr. ibid.pp.199-201. Mr.1894.

The formation of a drift deposit in northeastern Minnesota is described.

493 **Spurr,** J. E. Iron bearing rocks of the Mesabi Range in Minnesota. maps. Minneapolis, 1894. 268p. (M.G.S Bulletin no.10.)

Abstract. Am.Geol. 14:251-52. O.1894.

Review by T. C. Hopkins. Jour.Geol. 2:545-46. Jl. 1894.

Contents: General structure of the Mesabi Range, in the iron-bearing region. Minor stratigraphy of the western Mesabi. Microscopic study of the rocks of the iron-bearing member. Microscopic study of certain groups of the rocks of the iron-bearing member.

494 ———— . Iron ores of the Mesabi Range. Am.Geol. 13:335-45. diagr. My.1894.

Abstract. E.and M.J. 57:583-84. Je.23,1894.

Presents an outline for Bulletin no.10 of the Minnesota Geological Survey.

495 ———— Original source of the Lake Superior iron ores. Am.Geol. 29:335-49. Je.1902.

An account of investigation on the Mesabi Range.

496 ———— Preliminary report on field work done in 1893. M.G.S.for 1893. 22:115-24. 1894.

"Describes the origin and age of the granite of Giant's Range and describes the schists and Thompson slates of the Keewatin series, the Cretaceous outliers, and the glacial phenomena."

497 ———— The stratigraphic position of the Thompson slates. Am.Jour.Sci. 3d ser.48:159-66. 1894.

The Thompson slates of eastern Minnesota and their relation to surrounding rocks are discussed.

Stevens, G. C. *See* Follansbee,Robert, Horton, A. H. and Stevens, G. C. 179.

498 **Stoek,** H. H. Concentration of Mesabi ores. M. and M. 29:97-98. illus.flow-sheet. O.1908.

The Trout Lake concentrating plant is described.

499 ———— Marquette Range caving method. M.and M. 30:193-200. illus.diagrs. N.1909.

The practice described is that of the Marquette Range, but similar methods are used upon the other ranges in Michigan and Minnesota.

499a **Street,** A. L. H. Mining under public waters in Minnesota. E. and M. J. 99:892. My.22,1915.

A brief note on mining law in Minnesota.

500 **Streng,** A. and **Kloos,** J. H. Ueber die krystallinischen gesteine von Minnesota in Nord Amerika. Neues Jahrbuch. 1877:31-56; 113-38, 225-42.
Translation by N. H. Winchell. M.G.S. for 1882. 11:30-85. 1884.

This report is based on a study of the Keweenawan rocks of northeastern Minnesota.

501 **Stuntz,** G. R. Evidences of early man in northeastern Minnesota. Minn.Acad.Sci.Bull. 3:76-84. 1889.

502 ———— The mound builders in northeastern Minnesota. Their occupations and routes of travel. Minn. Acad. Sci.Bull. 3:84-88. illus. 1889.

Gives a brief description of a prehistoric stone dam across Pike River.

503 **Sturtevant,** H. B. Sinking through quicksand at the Susquehanna mine. L.S.M.I. 10:60-65. diagrs. 1904.
Reprint E.and M.J. 78:342-43. S.1,1904.
Reprint. Min.Wld. 21:210-11. Ag.27,1904.

504 **Swank,** J.M. Vermilion Lake iron district. U.S.G.S. Mineral resources. 1883-84:266-67; 1886:73-77.

504a **Swanson,** August. Annual report of the Inspector of mines, Crow Wing County. 1st-3d reports, June 1912—June 1915.

Contains statistics of mines, shipments, men employed, accidents and related matters.

T

505 **Taylor,** F. B. Changes of level in the region of the great lakes in recent geological time. Am.Jour.Sci. 3d ser. 49:69-71. 1895.

506 ———— Niagara and the Great Lakes. Am.Jour.Sci. 3d ser.49:249-70. 1895.

Outlines limits of a postglacial submergence in the vicinity of the Great Lakes.

507 **Taylor,** N. C. D. Report on the copper district of Kettle River, incorporating Mr. James Hall's estimates of the copper prospects of that district. Minn.Executive Doc.1866. 2p.

508 **Terry,** C. M. Hydrology of Minnesota. M.G.S. for 1880. 9:224-80. 1881.

Discusses rainfall, the drainage, heads and courses of the rivers and the value and utility of the lakes.

509 **Thom,** W. T. comp. [Mineral production of Minnesota.] U.S.G.S. Mineral resources. 1905-1913. For paging see index.

Tables give amount and value of all minerals found in the state.

523 **Todd,** J. E. Geology of Hubbard County and northwestern portions of Cass County. M.G.S. Final report. 4:81-97. illus.map. 1899.

524 ———— Geology of Marshall, Roseau and Kittson counties. M.G.S. Final report. 4:117-30. illus.map. 1899.

525 ———— Geology of Norman and Polk counties. M.G.S. Final report. 4:98-116. map. 1899.

526 ———— Has Lake Winnipeg discharged through the Minnesota within the last two hundred years? Am.Jour. Sci. 3d ser.17:120. 1879.

527 ———— Lineage of Lake Agassiz.(Abstract). Iowa. Acad.Sci.Proc. 1887-89:57-58. 1890.

Gives a sketch of the basin of Lake Agassiz from Eocene to Quaternary times.

528 ———— Preliminary report of a reconnaissance in northwestern Minnesota in 1892. M.G.S. for 1892. 21:68-78. 1893.

Describes the glacial geology of this region.

529 ———— Preliminary report of a reconnaissance in northwestern Minnesota during 1893. M.G.S. for 1893. 22:90-96. 1894.

Describes the general character of the region and the glacial deposits.

530 ———— Revision of the moraines of Minnesota. Am. Jour.Sci. 4th ser.6:469-77. map. Dec.1898.

Reviews work done by Mr. Upham on this subject.

531 **Tupper,** C. A. Biwabik iron mine. E.and M.J. 92: 1043-45. illus. Nov.25,1911.

A description of the mining methods used, the equipment, with a special note on the gyratory crusher.

532 ———— Construction of permanent ore-loading docks. Min.Wld. 37:185-88,239-42. illus.diagrs. Ag.3,10,1912.

532a ———— Extension of iron-ore washing on Minnesota ranges and elsewhere. Min.Wld. 42:891-93. illus.flowsheet. My.15,1915.

533 ———— Hydro-electric power for Minnesota ranges. Min.Wld. 36:643-47. illus. Mr.23,1912.

An account of the Great Northern Power Co.'s project near Duluth, and the extensive transmission system.

534 ———— Ore washing plant of the Oliver Iron Mining Co. Min.Wld. 35:949-54. illus. N.11,1911.

U

535 **Ulrich,** E. O. and **Scofield,** W. H. The Lower Silurian Gastropoda of Minnesota. M.G.S. Final report. 3:2:813-1081. plates. 1897.

536 **Ulrich,** E. O. The Lower Silurian Lamellibranchiata of Minnesota. M.G.S. Final report. 3:2:475-628. plates. 1897.

"Gives the author's terminology, methods of study, and classification. Describes many new species."

537 ———— Lower Silurian Ostracoda of Minnesota. M.G.S. Final report. 3:2:629-93. illus. 1897.

Describes many new species found in Minnesota, and gives a provisional classification.

538 ———— New Lamellibranchiata. Am.Geol. 10:94-104. Ag.1892.

"Describes one new genus, and eight new species, found in shaly strata equivalent to the Black River limestone."

539 ———— New Lower Silurian Lamellibranchiata, chiefly from Minnesota rocks. M.G.S.for 1890. 19:211-48. 1892. Abstract. Am.Jour.Sci. 3d ser.44:79. 1892.

540 ———— On Lower Silurian Bryozoa of Minnesota. M.G.S.Final report. 3:1:96-332. 1895.

541 ———— Report on the Lower Silurian Bryozoa, with preliminary description of some of the new species. M.G.S. for 1885. 14:55-103. 1886.

"Discusses the equivalency of the beds just above the Saint Peter sandstone in Minnesota and southward."

542 ———— Sceptropora: a new genus of Bryozoa, with remarks on Helopora (Hall) and other genera of that type. Am.Geol. 1:228-34. Ap.1888.

543 ———— Two new Lower Silurian species of Lichas (subgenus Hoplolichas). Am.Geol. 10:271-72. illus. N.1892.

Ulrich, E. O. *See also* Winchell, N. H. and Ulrich, E. O. 751, 763.

544 **U. S. Bureau of corporations.** Report of the Commissioner of Corporations on the steel industry. 3v. Washington. 1911-13.

Contains valuable material on the Minnesota Ranges, production, shipping, mining costs, ownership and related subjects.

545 **U. S. Census office,** 12th census, 1900. Minnesota mines and quarries. In special report on mines and quarries, 1902. pp.241-42.

546 **U. S. Census office,** 13th census, 1910. Minnesota mines and quarries. 11:102-04. 1913.

547 **U. S. Geological survey.** Topographic maps published to date are:—Anoka, Ashby, Barrett, Battle Lake, Chokio, Deerwood, Duluth, Fergus Falls, Herman, Minneapolis, Minnetonka, Morris, Rockford, St. Croix Dalles, St. Paul, Wahpeton, Wendell, White Bear.

548 **U. S. Geological survey.** Mineral resources of the United States. Washington, 1883-1914.

Contains annual statistics of production and value of all metals and non-metals in the U. S. For Minnesota see index.

549 **Upham,** Warren. Age of the St. Croix Dalles. Am.Geol. 35:347-55. Je.1905.

550 ———— Belts of knolly and hilly drift in Minnesota. Science. 3:695-96. Je.6,1884.

Paper read before the Minnesota Academy of Science.

551 ———— Chains of lakes in Martin County, as evidence of extensive recession and readvance of the ice sheet.(Abstract). Science. n.s.33:467-68. Mr.24,1911.

552 ———— Changes in the current of ice of the last glacial epoch in eastern Minnesota. Am.Assoc.Adv.Sci. 32: 231-34. 1883.
Reprint. Minn.Acad.Sci.Bull. 3:51-56. 1889.

553 ———— Criteria of englacial and subglacial drift. Am. Geol. 8:376-85. D.1891.

Gives six characters to distinguish the englacial from the subglacial till.

554 ———— Description of maps showing the climate, geography, and geology of Minnesota. Minn.Acad.Sci.Bull. 3:151-55. 1889.

555 ———— Discovery of Minnesota and the upper Mississippi. In Memoirs of explorations, by J. V. Brower. 6:86-104. 1903.

556 ———— Englacial and superglacial drift in Minnesota, the Dakotas, and Manitoba.(Abstract). Minn.Acad.Sci. Bull. 4:428-29. 1910.

557 ———— Fluctuations of the Keewatin and Labradorian ice currents in the vicinity of Minneapolis and St. Paul. (Abstract). Science. n.s.33:466-67. Mr.24,1911.

558 ———— Geology of Aitkin County. M.G.S. Final report. 4:25-54. map. 1899.

Description of the physical features of the county, the eruptive and Cretaceous rocks, and gives notes on glacial history.

559 ———— Geology of Cass County and of the part of Crow Wing County northwest of the Mississippi River. M.G.S. Final report. 4:56-81. 1899.

Physiographic and geologic features described.

560 ———— Geology of deposits containing vestiges of man in Minnesota. Am.Nat. 18:706-08. Jl.1884.

561 **Upham,** Warren Geology of Prairie Island. In Memoirs of explorations, by J. V. Brower. 6:34-38. 1903.

562 ———— Geology of [the central counties of Minnesota.] M.G.S. Final report. 2:102-263,399-671. maps. 1888.

Includes Carver, Scott, Sibley, Nicollet, McLeod, Renville, Swift, Chippewa, Kandiyohi, Meeker, Wright, Chisago, Isanti, Anoka, Benton, Pine, Sherburne, Stearns, Douglas, Pope, Grant, Stevens, Wilkin, Traverse, Clay, Ottertail, Wadena, Todd, Crow Wing, Morrison, Millelacs, Kanabec, Becker.

563 ———— Geology of the region around Red Lake and southward to White Earth. M.G.S. Final report 4:155-65. 1899.

Describes the topography and glacial geology.

564 ———— Geology of the southern counties of Minnesota. M.G.S. Final report. 1:404-532, 562-647. geol. maps. 1884.

Includes Waseca, Blue Earth, Faribault, Watonwan, Martin, Cottonwood, Jackson, Murray, Nobles, Brown, Redwood, Yellow Medicine, Lyon, Lincoln, Big Stone, Lac qui Parle, Le Sueur, and Rice counties.

565 ———— Glacial and modified drift in Minneapolis. Am. Geol. 25:273-99. map. My.1910.
Abstract. Am.Assoc.Adv.Sci. 48:229. 1899.
Abstract. Science, n.s.10:490. O.6,1899.

566 ———— Glacial and modified drift of the Mississippi Valley from Lake Itasca to Lake Pepin. Minn.Acad.Sci. Bull. 4:299-305. map. 1906.

567 ———— Glacial drift and its terminal moraines. M.G.S. for 1880. 9:281-356. 1881.
Abstract. Am.Jour.Sci. 3d ser. 23:62-63. 1882.

568 ———— Glacial Lake Agassiz. U.S.G.S.Monograph no.25. 1896.

"Describes the topography of the lake basin, the character and distribution of the Archean, Silurian, Devonian and Cretaceous beds underlying the drift, and also of the drift deposits. Discusses the history of Lake Agassiz, the formation of the beaches and deltas and of changes of the level of the beaches. Gives an account of the artesian wells of the Red River valley and of the economic features of the region.

569 ———— Glacial Lake Hamline. Am.Geol. 19:423. Je.1897.

Abstract of a lecture on a glacial lake which covered much of the western area of St. Paul.

570 ———— Glacial moraines of Minnesota. Minn.Acad. Sci.Bull. 3:12. 1889.

"Short notice of paper. Classified list of moraines, and statement in regard to their lateral nature."

571 ———— History of mining and quarrying in Minnesota. Minn.Hist.Soc.Coll. 8:2:291. 1898.

572 **Upham,** Warren. Inequality of distribution of englacial drift [in Minnesota.] Geol.Soc.Am.Bull. 3:134-48. Mr.9,1892.

573 ———— Lake Agassiz, a chapter in glacial geology. M.G.S. for 1882. 11:135-53. 1884.
Reprint. Minn.Acad.Sci.Bull. 2:290-314. D.1882.
Abstract. Am.Nat. 18:1124-25. 1884.
Abstract. Science. 1:220. 1883.

574 ———— Man in the Ice Age of Lansing, Kansas and Little Falls, Minn. Am.Geol. 30:135-50. S.1902.

"Describes the deposits in which the remains were found and gives estimates of the duration of the various divisions of the Ice Age."

575 ———— Minnesota [altitudes.] U.S.G.S. Bulletin 72:198-200, 206-14. 1891; 274:472-501. 1906.

576 ———— Minnesota Valley in the Ice Age. Am.Assoc. Adv.Sci. 32:213-31. 1883.
Reprint. Am.Jour.Sci. 3d ser.27:34-42, 104-11. 1884.
Abstract. Science. 2:318-19 S.7,1883.
Abstract. Am.Jour.Sci. 3d ser.26:327. 1883.

577 ———— Modified drift in St. Paul. Geol.Soc.Am.Bull. 8:183-96. maps. F.27,1897.
Abstract. Science. n.s.33:466-67. Mr.24,1911.

578 ———— Notes on rock outcrops in central Minnesota. M.G.S. for 1882. 11:86-153. 1884.

The crystalline rocks of Morrison, Stearns and Benton counties are described.

579 ———— Pleistocene ice and river erosion in the Saint Croix Valley of Minnesota and Wisconsin. Geol.Soc.Am. Bull. 12:13-24. 1900.

Summary is given of the St. Croix geological history. Describes the drainage changes in this region, due to the erosion.

580 ———— Preliminary report of field work during 1893 in northeastern Minnesota, chiefly relating to the glacial drift. M.G.S. for 1893. 22:18-66. 1894.

"Describes the topography and the Archean outcrops of the region. Discusses the evidences of Cretaceous beds underlying the drift, and describes the glacial deposits."

581 ———— Preliminary report on the geology of central and western Minnesota. M.G.S. for 1879. 8:70-125. 1880.

Gives a description of the granites and gneisses of the Minnesota Valley.

582 ———— Recent visit to Lake Itasca. Am.Acad.Sci.Bull. 3:284-92. 1892.

Glacial phenomena in this region is described.

583 ———— Recession of the ice sheet in Minnesota, and its relation to the gravel deposits overlying quartz implements found by Miss Babbitt at Little Falls. Bost.Soc.Nat.Hist. 23:436-47. D.21,1888.

584 **Upham,** Warren. Remarkable chain of lakes in Martin County. Science. 3:695. Je.6,1884.

A paper read before the Minnesota Academy of Science, on the eastern, central and western chain of lakes.

585 ———— Report of exploration of the glacial Lake Agassiz in Manitoba. Canada.Geol.Survey. Annual report for 1888-89. n.s.v.4,part E. 1890.
Abstract. Am.Geol. 7:188-94,222-31. Mr.Ap.1891.
Abstract. Am.Jour.Sci. 3d ser.42:429. 1891.
Abstract. Geol.Mag. 3d decade.8:228-29. My.1891.

586 ———— The Sangamon interglacial stage in Minnesota and westward. Int.Geol.Cong.12th. Canada, 1913. pp. 455-65. 1914.

"Discusses the occurrence and relations of drift deposits and the phenomena assigned to the Sangamon interglacial stage, and the length and cause of the ice age."

587 ———— Tertiary and early Quaternary baseleveling in Minnesota, Manitoba and northwestward. Am.Geol. 14:235-46. O.1894.
Abstract. Am.Geol. 14:199. S.1894.
Abstract. Geol.Soc.Am.Bull. 6:17-20. N.23,1894.
Abstract. Jour.Geol. 2:754. O.1894.

588 ———— The topography and altitude of Minnesota. (Abstract). Minn.Acad.Sci.Bull. 3:57-58. 1889.

589 ———— The upper beaches and deltas of the glacial Lake Agassiz. U.S.G.S. Bulletin no.39. maps. 1887.

Attention is given to the upper or Herman beach in Minnesota and Dakota.

590 ———— Walden, Cochitaute and other lakes enclosed by modified drift. Boston Soc.Nat.Hist. 25:228-42. F.18,1891.

Describes many glacial lakes in Massachusetts, Maine, New Hampshire, Rhode Island and Minnesota.

591 **Van Barneveld,** C. E. Iron mining in Minnesota. illus. diagrs.maps. Minneapolis,1912. 215p. (Minn.School of Mines Exp.Station. Bulletin no.1.)
Review. E.and M.J. 95:1258. Je.21,1913.
Abstract. E.and M.J. 95:1295. Je.28,1913.
Excerpt. Choice of mining methods on the Mesabi. E. and M.J. 96:592. S.27,1913.
Excerpt. Cost of equipping a Mesabi underground mine. E.and M.J. 96:549-50. S.20,1913.
Excerpt. Mesabi shaft collars. E.and M.J. 96:546. S.20,1913.
Excerpt. Mesabi station cutting. E.and M.J. 96:449-50. S.6,1913.
Excerpt. Openpit mining under difficulties. E.and M.J. 96:497. S.13,1913.

Van Barneveld, C. E. Iron mining in Minnesota. (Cont'd.)
Excerpt. Shaft sinking in Minnesota iron mining. E.and M.J. 96:739-40. O.18,1913.
Excerpt. Underground costs in Minnesota iron mining E.and M.J. 96:408. Ag.30,1913.

592 **Van Hise,** C. R. An attempt to harmonize some apparently conflicting views of Lake Superior stratigraphy. Am.Jour. Sci. 41:117-37, 383-86. F.,Je.1891.
Review by A. C. Lawson, Am.Geol. 7:320-27,388 My.1891.

Quotes from works of prominent geologists.

593 ——— Correlation papers. Archean and Algonkian. U.S.G.S. Bulletin no.86. maps. 1892.

Minnesota pp.119-34.

594 ——— Enlargements of hornblende fragments. Am. Jour.Sci. 3d ser.30:231-35. D.1885.
Abstract. Am.Nat. 19:1216. D.1885.

595 **Van Hise,** C. R. and **Leith,** C. K. Geology of Lake Superior region. U.S.G.S. Monograph no.52. maps. 1911. 641p.
Abstract. Wash.Acad.Sci.Jour. 1:157-60. O.1911.
Review by J. F. Kemp. Econ.Geol. 7:595-99. S.1912.
Review by E. S. Moore. Jour.Geol. 20:184-90. F.1912.

"Reviews the history of mining in the Lake Superior region and the geologic work and describes the physiographic features and glacial geology, the stratigraphy of the different iron and copper districts, and the distribution, relations, and origin of the ores."

596 **Van Hise,** C. R. An historical sketch of the Lake Superior region to Cambrian time. Jour.Geol. 1:113-28. map. F.1893.

597 ——— **Leith,** C. K., and **Clements,** J. M. Iron ore deposits of the Lake Superior region. U.S.G.S. Annual report for 1899-1900. map. 21:3:305-434. 1900.

"Brief description and comparison of the various iron-bearing districts."

Mesabi district, by C. R. Van Hise and C. K. Leith, pp.351-70.

Vermilion district, by C. R. Van Hise and J. M. Clements, pp.401-09.

598 **Van Hise,** C. R. Report. Lake superior division. U.S.G.S. Annual report for 1888-89. 10:1:123-28. 1890.

Contains a short review of the Pigeon Point region, pp.125-27.

599 ——— Report of the special committee for the Lake Superior region. Jour.Geol. 13:89-104. F.1905.

"Describes the investigations of a special committee of geologists of the Geological survey of Canada and of the U.S.G.S., upon the relations, classification and nomenclature of the formations of the Lake Superior region, and gives their conclusions in tabular form."

Van Hise, C. R. *See also* Irving, R. D. and Van Hise, C. R. 313, 318.

600 **Van Slyke,** W. R. Reclamation of paint rock ores. Ir.Trd. Rev. 54:1091-92. Je.18,1914.

Gives table of costs for sintering iron ores.

601 **Virtue,** G. O. Minnesota iron ranges. Washington, 1909. U.S.Bureau of Labor Bulletin for Sept. 1909. pp.338-96.

Gives information concerning production, transportation, labor, mining methods, wages, cost of living and related matters.

602 **Vogdes,** A. W. On the North American species of the genus Agnostus. Am.Geol. 9:377-96. Je.1892.

603 **Wadsworth,** M. E. Notes on the geology of the copper and iron districts of Lake Superior. Harvard Mus.Comp.Zool. 7:1-157. 1884.

Reviewed by J. D. Dana. Am.Jour.Sci. 3d ser.20:330-32. 1880.

Abstract. ibid. 22:403-08. 1881.

604 ———— Preliminary description of the peridotytes, gabbros, diabase and andesytes of Minnesota. St.Paul,1887. 158p. (M.G.S.Bulletin no.2.)

Abstract. Am.Nat. 22:452-53. 1887.

605 **Walcott,** C. D. Correlation papers. Cambrian. U.S.G.S. Bulletin no.81. 1891.

Minnesota, pp.181-87, 334.

606 ———— Description of new forms of Upper Cambrian fossils. U.S.Nat.Mus.Proc. 13:266-79. 1890.

Fossils from Minnesota are included.

607 ———— The Utica slate and related formations of the same geological horizon. Albany Inst.Trans. 10:1-17. 1883.

608 **Warren,** G. K. Minnesota River. Letter from the Secretary of War transmitting a report of the results of the examination and survey of the Minnesota River. 43d Congress, 2d Session, H.E.Doc.no.76. plates,map. 1875. 72p.

Abstract. Am.Jour.Sci. 3d ser.9:313. 1875.

Contents: Account of examinations and surveys of the Minnesota River. An essay concerning important physical features exhibited in the Valley of the Minnesota River, and upon their significance. Capabilities of the Minnesota River and valley for commodious water transportation.

609 ———— Valley of the Minnesota River and of the Mississippi River to the junction of the Ohio; its origin considered; depth of the bed-rock. Annual Rept. of the Chief of Engineers for 1878. Appendix X3,pp.909-26. plates. 1878.

Excerpt. Am.Jour.Sci. 3d ser.16:417-31. plates,map. 1878.

610 ———— On certain physical features of the upper Mississippi River. Am.Nat. 2:497-502. N.1868.

Abstract of a paper read before the American Association for the Advancement of Science.

611 **Warren,** O. B. Mahoning iron mine. Ir.Age. 64:1-3. illus. N.9,1899.

Detailed description of methods of working this mine, the machinery equipment and the sampling system.

612 **Webb,** F. J. Report of the Inspector of mines of St. Louis Co. for 1907-08. Minn.Bur.of Labor. 11:196-217.

Tables showing classification of labor employed, average wages, fatal accidents, minor accidents and causes, shipments, list of mines with company operating and location.

613 **Wedding,** H. Mining methods on the Mesabi Range. Stahl und Eisen. 16:7-13. 1896. (Not seen.)

Illustrations taken from Harper's Weekly and Iron Age.

Wesbrook, F. F., *See* Dole, R. B. and Wesbrook, F. F. 125.

614 **White,** C. A. Correlation papers. Cretaceous. U.S.G.S. Bulletin no. 82. 1891.

Minnesota, p.142,165.

615 ———— Observations on the red quartzite bowlders of western Iowa, and their original ledges of red quartzite in Iowa, Dakota and Minnesota. Am.Assoc.Adv.Sci. 17: 340-42. 1869.

616 ———— Trip to the great red pipestone quarry. Am.Nat. 2:644-53. 1869.

617 **Whitney,** J. D. On the occurrence of the ores of iron in the Azoic system. Am.Assoc.Adv.Sci. 9:209-16. 1856.
Reprint. Am.Jour.Sci. 2d ser.22:38-49. 1856.
Reprint. Min.Mag. 7:67-73. 1856.

The Lake Superior district is compared with the iron regions of Scandinavia, Missouri, and northern New York.

618 ———— Remarks on some points connected with the geology of the north shore of Lake Superior.(Abstract). Am.Assoc.Adv.Sci. 9:204-09. 1856.

619 ———— Remarks on the Huronian and Laurentian systems of the Canada Geological survey. Am.Jour.Sci. 2d. ser.23:305-14. 1857.

A study of the age of the great sandstone formation which spreads over Wisconsin and Minnesota.

Whitney, J. D., *See* Foster, J. W. and Whitney, J. D. 181,182; Hall, James and Whitney, J. D. 271.

620 **Whittlesey,** Charles. Ancient mining on the shores of Lake Superior. Smithsonian Contributions,v.13. diagrs.maps. 1863.

621 ———— Drift of the northern and western states. Annals of Science.(Cleveland). 1:47-48,57-59. 1854.

622 ———— On the fresh-water glacial drift of the northwestern states. Smithsonian Contributions,v.15. illus. map. 1867.

623 **Whittlesey,** Charles On the ice movements of the glacial era in the valley of the St. Lawrence. Am.Assoc.Adv.Sci. 15:43-54. 1867.

Table gives "Bearing of the glacial etchings upon the rocks on and adjacent to the waters of the northern lakes, in the U. S. and in Canada."

624 ——— On the "superficial deposits" of the northwestern part of the United States. Am.Assoc.Adv.Sci. 5:54-57. 1851.

Presents sections from many localities in the northwestern states to prove that the same order of stratification has taken place.

625 ——— Physical geology of Lake Superior. Am.Assoc. Adv.Sci. 24:2:60-72. map.tables,diagrs. 1875.

The rocks at Vermilion Lake are compared to the Laurentian of Canada.

626 ——— Report of explorations in the mineral region of Minnesota during the years 1848, 1859, and 1864. maps. Cleveland,1866. 54p.

Contents: General geology. Phenomena of the drift period. General elevations in Minnesota. Fluctuations in the level of the lakes. Climate.

627 ——— St. Louis and Vermilion Rivers, Minnesota. Cleveland Acad.of Sci. maps. D.11,1856.
Reprint. Geol.Jour. ?:1-16. Ag.1848.

628 **Wilcox,** L. L. Mesabi Company locations. E. and M.J. 97:841-43. illus.diagrs. Ap.25,1914.

Describes houses built by the Republic Iron and Steel Co., at various places on the Mesabi Range, for their employees.

629 **Wilkinson,** C. D. Systems of mining in Minnesota iron mines. U.of M.Eng.Soc. 3:47-51. My.1895.
Reprint. Colliery Engineer. 16:154. F.1896.

Willard, D. E., *See* Hall, C. M. and Willard, D. E. 239.

630 **Willey,** D. A. Lake Superior and Cuban iron ores. M.and M. 33:340-42. illus. Ja.1913.

Notes on the ownership of the deposits.

631 ——— World's greatest iron-ore deposits. Eng.Mag. 44:867-85. illus. Mr.1913.

Deals with the character and extent of the Cuban iron ore deposits, using similar data from the Lake Superior region as a basis for comparison.

632 **Williams,** H. S. Correlation papers. Devonian and Carboniferous. U.S.G.S. Bulletin no.80. 1891.

Minnesota pp.167-68.

633 **Williams,** R. D. Transportation of iron ore on the Great Lakes. Ir.Trd.Rev. 48:545-54,715-21. illus. Mr.16, Ap.13,1911.

The history of ore transportation is reviewed, with descriptions of modern ore docks, ore boats and handling machinery.

634 **Williamson,** A. W. Minnesota geographical names derived from the Dakota language, with some that are obsolete. M.G.S.for 1884. 13:104-12. 1885.

635 **Willis,** Bailey. Index to the stratigraphy of North America. U.S.G.S. Professional paper no.71. 1912.

See index for Minnesota references.

636 ———— Report of a trip on the upper Mississippi and to Vermilion Lake. U.S.Census office, 10th census, 1880. Report on the mining industries of the U. S. 15:457-67. maps. 1886.

"Description of the geology and the iron bearing and associated strata, and discussion of their structural and stratigraphic relations."

637 **Wilson,** G. L. Sandrock sewers of St. Paul. Am.Soc.of Civil Eng. 32:195-204. illus. Ag.1894.

638 **Wilson,** H. M. and others. Triangulation and spirit leveling in Minnesota. U.S.G.S. Annual reports. 18:1:161-62; 19:1:259-60; 20:1:261-62; 21:1:272, 276-78, 471-7. 1896-1900.

639 **Winchell,** Alexander. Conglomerates enclosed in gneissic terranes. Am.Geol. 3:153-65,256-62. Mr.Ap.1889.

The region studied lies on and near the international boundary line between Minnesota and Canada.

640 ———— Field studies in the Archean rocks of Minnesota, with accessory observations in Ontario, Michigan and Wisconsin. Ann Arbor,1899. 504p.

Reprint of reports from the Minnesota Geological Survey, 1886-87.

641 ———— Geological position of the Ogishke conglomerate. (Abstract) Am.Assoc.Adv.Sci. 38:234-35. 1890.

Conglomerate found in the basin of Kingfisher Lake, brings proof "to show the Ogishke to be a part of the Vermilion iron formation."

642 ———— Last word with the Huronian. Geol.Soc.Am. Bull. 2:85-124. F.5,1891.
Abstract. Am.Geol. 7:261. Ap.1891.
Abstract. Am.Nat. 25:651-52. Jl.1891.

643 ———— Report of a geological survey of Minnesota. during the season of 1887. M.G.S.for 1887. 16:133-391. 1888.
Abstract. Am.Jour.Sci. 3d.ser.37:497-98. 1889.

Much of this report deals with districts outside of the state, but has direct bearing on some of the problems of Minnesota geology.

644 ———— Report of a geological survey of the vicinity of Belle Plaine, Scott County, Minnesota. St.Paul,1872. 16p.

645 ———— Report of geological observations made in northeastern Minnesota during the season of 1886. M.G.S.for 1886. 15:5-207. map. 1887.

646 **Winchell,** Alexander Some results of Archean studies. Geol. Soc.Am.Bull. 1:357-90,392-93. Ap.15,1890.
Abstract. Am.Geol. 5:121. 1890.
Abstract. Am.Nat. 24:291-92. 1890.

Discussions of the crystalline rocks of the Northwest, especially those in the northeastern portion of Minnesota.

647 ———— Systematic result of a field study of the Archean rocks of the Northwest.(Abstract) Am.Assoc.Adv.Sci. 37:205-06 1889.
Abstract. Science. 12:100. Ag.31,1888.

"Summary statement of stratigraphic succession and equivalency of the crystalline series of the northwest."

648 ———— Uncomformability between Animikie and the Vermilion series. Am.Jour.Sci 3d ser.34:314. 1887.

649 ———— Unconformities of the Animikie in Minnesota. Am.Geol. 1:14-24. diagrs. 1888.

Full details are published in M.G.S.for 1887. 16:133-391. 1888.

650 **Winchell,** A. N. Étude minéralogique et pétrographique des roches gabbroiques de l'État de Minnesota, États-Unis, et plus spécialement des anorthosites. illus. Paris, 1900. 164p.
Abstract. Am.Jour.Sci. 4th ser.11:89. 1901.

651 ———— The Koochiching granite. Am.Geol. 20:293-99. N.1897.

"Describes the magascopic and microscopic and chemical characters of the granite."

652 ———— Mineralogical and petrographic study of the gabbroid rocks of Minnesota, and more particularly of the plagioclasytes. Am. Geol. 26:151-88, 197-245, 261-306, 348-88. S.-D.1900.

This paper is practically a translation of a thesis presented to the faculty of the University of Paris, to obtain the degree of Doctor of Sciences.

653 ———— Minnesota's eastern, southern and western boundaries. Minn.Hist.Soc.Coll. 10:2:677-87. 1905.

654 ———— Minnesota's northern boundary. Minn.Hist. Soc.Coll. 8:185-212. 1896.

655 ———— Note on titaniferous pyroxene. Am.Geol. 31:309-10. My.1903.

"Discusses composition and optic angle of this mineral found in Duluth and at Pigeon Point."

656 **Winchell,** H. V. Bit of iron range history. Am.Geol. 13: 164-70. Mr.1894.

An account of the part a knowlege of geology had in the discovery of the iron ore deposits of Minnesota.

657 **Winchell,** H. V. Characteristic American metal mines.—The mines of the Minnesota Iron Co. Eng.Mag. 13:872-95. illus.map. S.1897.
Excerpt. Ir.Trd.Rev. 40:14-15. S.9,1897.

Describes several mines of the Minnesota Iron Co. and discusses mining and transportation problems.

658 ———— and **Jones,** J. T. The Biwabik mine. A.I.M.E. 21:951-61. diagrs. 1892-93.

The character of the ore, open pit mining methods, and equipment of this Mesabi Range mine are described.

659 **Winchell,** H. V. Cost of mining on the Mesabi. Ir.Trd.Rev. Jl.21,1892. (Not seen.)

660 ———— Diabasic schists containing the jaspilyte beds of northeastern Minnesota. Am.Geol. 3:18-22. Ja.1889.

"The jaspilyte is regarded as a sedimentary formation which was broken up and involved in the eruptions of the Keewatin age."

661 ———— Genesis of ore deposits. A.I.M.E. 24:957-62, 23:591-93. 1894.
Reprint. Genesis of ore deposits, by Frank Posepny. pp.227-32. 1902.

Discussion brought out by Prof. Posepny's paper on this subject. The ores of the Mesabi Range are given particular mention.

662 ———— Geological age of the Saganaga granite. Am. Jour.Sci. 3rd ser.41:386-90. My.1891.

663 ———— Historical sketch of the discovery of mineral deposits in the Lake Superior region. L.S.M.I. 2:33-78. 1894.
Reprint. M.G.S.for 1894. 23:116-55. 1895.

Contains a bibliography pp.71-78.

664 ———— Iron ranges of Minnesota. L.S.M.I. 3:11-32. map. 1895.

Describes many of the Vermilion and Mesabi Range mines.

665 ———— Iron resources of Minnesota. Ir.Trd.Rev. v49. D.5,1895. 3500 words. (Not seen)

"Valuable statistics given, and the economic phase of the industry fully discussed."

666 ———— Is there a shortage of bessemer ore? Ir.Trd.Rev. F.16,1893. (Not seen).

667 ———— Lake Superior iron-ore region. I.M.E.Trans. 13:493-562. tables,map. 1896.
Review. Zeit. für prak. Geol. 6:207-12. 1898.

Contains a bibliography pp.546-48. A comprehensive study of the whole Lake Superior region, giving prominence to the Minnesota ranges.

668 ———— Mesabi developments. Ir.Trd.Rev. Ap.19, 1893. (Not seen).

669 **Winchell,** H. V. Mesabi iron range. E.and M.J. 76:343-44. S.5,1903.

A letter concerning the geologic work done on the Mesabi Range by Minnesota geologists.

670 ———— Mesabi iron Range. A.I.M.E. 21:644-86. diagrs.tables. 1892-93.
Reprint. M.G.S. for 1891. 20:111-80. 1893.
Abstract. E. andM.J. 55:177-78. F.25,1893.
Abstract. Am.Geol. 9:355-56. My.1893.

"Describes the geology of the Mesabi Range, the stratigraphic relations of the Taconic and Archean rocks and the occurrence and quality of the ore and its varieties, and discusses the question of its origin."

671 ———— Minnesota iron mines in 1898. Ir.Trd.Rev. 30:7-10. illus. Ja.7,1897.

An account of conditions in Minnesota during the period of consolidation of interests on the Ranges. Brief notes are given on methods of mining, and the production of 1895-96.

672 ———— Minnesota iron mining economically and statistically considered. M.G.S.Final report. 4:581-616. illus. map. 1899.

Contents: Geographical. Historical. Quality of the ores. Methods of exploitation. Transportation. Market prices of iron ores. Lake Superior iron ore shipments for 1898 and previous 43 years. Future of iron mining in Minnesota. Comparative costs here and elsewhere.

673 ———— Note on Cretaceous in northern Minnesota. Am.Geol. 12:220-23. O.1893.

"Gives a list of fossils, determined by Dr. C. A. White to be of Cretaceous age, found in northern Minnesota. Describes other localities in which Cretaceous strata occur."

674 ———— and **Grant,** U. S. Preliminary report on the Rainy Lake gold region. M.G.S.for 1894. 23:36-105. illus.map. 1895.
Reprint. M:G.S.Final report. 4:192-211. 1899.

"The description of the geology and the general physical features of the district applies especially to that part of the lake and its shores lying in Minnesota."

675 **Winchell,** H. V. Report of field observations made during the season of 1888, in the iron regions of Minnesota. M.G.S. for 1888. 17:77-145. 1889.

"Descriptions of numerous outcrops of the iron formation, Giant's Range syenite, and the gabbro are given."

676 ———— Report of observations made during the summer of 1887. M.G.S.for 1887. map. 1888.

This report covers a wide territory in the region of Rainy Lake.

677 ———— Reputed nickel mines in Minnesota. E.andM.J. 64:578. N.13,1897.

Winchell, H. V. *See also* Winchell, N. H. and Winchell, H. V. 757, 791, 818.

678 **Winchell,** N. H. Age of the Galena limestone. Am.Geol. 15:33-39. Ja.1895.

Gives paleontological data to prove the age of the rocks, giving the fossil characteristics of certain horizons.

679 ———— Age of the Mesabi iron-bearing rocks of Minnesota.(Abstract) Science. n.s.37:457. Mr.21,1913.

680 ———— Animikie black slates and quartzytes and the Ogishke conglomerate of Minnesota, the equivalent of the "original Huronian". Am.Geol. 1:11-14. Ja.1888.

681 ———— Approximate interglacial chronometer. Am. Geol. 10:69-80. Ag.1892.

"Explains the evidences which indicate that the ancient Mississippi River once occupied a wider and deeper valley in Minnesota."

682 ———— The Arlington iron. Minnesota no.2. Am. Geol. 18:267-71. illus. N.1896.

683 ———— The Baraboo iron ore. Am.Geol. 34:242-53. O.1904.

A review of Samuel Weidman's report on the Baraboo iron bearing district of Wisconsin. Compares the conclusions reached by Dr. Weidman with those held by the Minnesota geologists.

684 ———— The Belleplaine salt well. M.G.S.for 1873. 2:79-87. 1874.

685 ———— Building stones, clays, limes, cements, roofing, flagging and paving stones of Minnesota. Minneapolis,1880. 37p. (M.G.S.Miscellaneous publications no.8)

686 ———— Building stones of Minnesota. M.G.S.Final report. 1:142-204. 1884.

687 ———— Chart of geological nomenclature intended to express the relation of Minnesota to the great geological series of the earth, and the probable equivalency of some of the names the formation has received in the various states and in Europe. M.G.S.for 1872. v.1,chart opposite p.38. 1873.

688 ———— Clay pebbles from Princeton, Minn. Am.Assoc. Adv.Sci. 32:238. 1883.
Abstract. Science. 2:324. S.7,1883.

689 ———— Comparative strengths of Minnesota and New England granites.(Abstract) Am.Assoc.Adv.Sci. 32:249-50. tables. 1883.
Abstract. Science. 2:324-25. S.7,1883.

690 ———— Contributions to the mineralogy of Minnesota. Am.Geol. 1898-99.

Contents: Note on the character of mesolite from Minnesota. 22:228-30. O.1898.—pt.2. Thomsonite and lintonite from the north shore of Lake Superior. 22:347-49. D.1898. —pt.3. Thalite and bowlingite from the north shore of Lake Superior. 23:41-44. Ja. 1899.—pt.4. Chlorastrolite and zonochlorite from Isle Royale.

Winchell, N. H. Contributions to the mineralogy of Minnesota. (Contents continued.)

23:116-18. F.1899.—pt.5. Common zeolites of the Minnesota shore of Lake Superior 23:176-77. Mr.1899.—pt.6. The optical characters of Jacksonite. 23:250-51. Ap.1899.—pt.7. Adularia and other secondary minerals of the copper-bearing rocks. 23:317-18. My.1899.

691 ———— Cretaceous in Minnesota. Minn.Acad.Sci.Bull. 1:347-49. 1880.

692 ———— Crucial points in the geology of the Lake Superior region. Am.Geol. 1895.

Contents: pt. 1. Stratigraphic base of the Taconic or Lower Cambrian. 15:153-62. Mr.1895.—pt.2. Paleontological base of of the Taconic or Lower Cambrian. 15:229-34. Ap.1895.—pt.3. Eruptive epochs of the Taconic or Lower Cambrian. 15:295-304. My.1895.—pt.4. Canadian localities of the Taconic eruptives. 15:356-63. Je.1895.—pt.5. Steps of progressive research in the geology of the Lake Superior region prior to the late Wisconsin survey. 16:12-20. Jl.1895.—pt.6. Keweenawan according to the Wisconsin geologists. 16:75-86. Ag.1895.—pt.7. Rational view of the Keweenawan. 16:150-62. S.1895.—pt.8. Synchronism of the Lake Superior region with other portions of the North American continent. 16:205-13. O.1895.—pt.9. The latest eruptives of the Lake Superior region. 16:269-74. N.1895.—pt.10. Comparative taxonomy of the rocks of the Lake Superior region. 16:331-37. S.1895.

693 ———— Crystalline rocks. M.G.S.for 1891. 20:1-28. illus. 1893.

Discusses the general age of the crystalline rocks of northeastern Minnesota and gives the descending succession of the strata.

694 ———— Crystalline rocks of Minnesota. M.G.S.for 1884 13:36-38. 1885.

695 ———— Crystalline rocks of Minnesota. M.G.S.for 1888. 17:5-74. 1889.
Abstract. Am.Geol. 5:59-60. 1889.
Review by J. D. Dana. Am.Jour.Sci. 3d ser.39:167-68. 1890.

Reviews the work of the Minnesota geological survey on the crystalline rocks, comparing results with those of other districts. A statement is made of unsolved problems.

696 ———— Crystalline rocks of the Northwest. Am.Assoc. Adv.Sci. 33:363-79. 1885.
Reprint. M.G.S.for 1884. 13:124-40. 1885.
Reprint. Am.Nat. 18:984-1001. 1884.
Abstract. Am.Jour.Sci. 30:397. 1885.
Abstract. Science. 4:238-40. 1884.

697 ———— Cupriferous series at Duluth. M.G.S.for 1879. 8:22-26. 1880.

698 ———— Cupriferous series in Minnesota. Am.Assoc. Adv.Sci. 29:422-25. 1881.
Reprint. M.G.S. for 1880. 9:385-87. 1881.
Abstract. Science. 1:197. 1880.

699 **Winchell,** N H Cuyuna iron Range. Econ.Geol. 2:565-71. map. S.1907.

Describes the geologic structure.

700 ———— Dall's observations on Artic ice and the bearing of the facts on glacial phenomena in Minnesota. Am.Jour. Sci. 3d ser.21:358-60. 1881.

701 ———— The deep well at Lakewood cemetery, Minneapolis. M.G.S.for 1884. 13:50-54. 1885.

702 ———— Deep wells as a source of water for Minneapolis. Am.Geol. 35:266-91. map. My.1905.
Abstract. Minn.Acad.Sci.Bull. 4:266. 1906.

Discusses the water bearing strata, cost of drilling wells, composition of the water, and a map of basins and wells.

703 ———— Diamond drill core section of the Mesabi Range. L.S.M.I. 14:156-78; 15:100-41; 16:61-69. 1909-1911.
Summary. Min.Wld. 35:377-78. Ag.16,1911.

"Describes the microscopic characters of the rocks passed through in a drilling in the Mesabi Range, Minnesota."

704 ———— Discovery and development of the iron ores of Minnesota. Minn.Hist.Soc.Coll. 8:1:25-40. map. 1895.

Describes three horizons of iron-bearing rocks; The titanic ores of the gabbro belt; Iron ores of the Mesabi Range; Hematite of the Vermilion ores.

705 ———— The drift deposits of the Northwest. Pop.Sci. Mo. 3:202-10. diagrs. Jl.1873.
Review by J. D. Dana. Am.Jour.Sci. 3d ser.13:64-65. 1876.

A comprehensive study of the drift of Minnesota is the basis of this report.

706 ———— Eastern equivalent of the Minnesota iron ores. M.G.S. Bulletin 6:411-19. 1891.

Compares the ore deposits of Minnesota with those of New York and western New England.

707 ———— Extinct Pleistocene mammals of Minnesota. Minn.Acad.Sci.Bull. 4:414-22. illus. 1910.

"Describes the occurrence and character of remains of the Elephas primigenius (mammoth), Casteroides ohioensis, Ovibus cavifrons, and Bison (latifrons?)"

708 ———— Field notes for 1886. M.G.S.for 1887. 16:13-129. 1888.

Report of a reconnaissance of the area of the original Huronian of Michigan and Wisconsin having a direct bearing upon the stratigraphy of the rocks of northeastern Minnesota.

709 ———— Field notes in 1890. M.G.S.for 1891. 20:29-34. 1893.

"Gives notes on some rock exposures in northeastern Minnesota."

710 ———— Field observations in 1892. M.G.S.for 1892. 21:79-134. diagrs. 1893.

Brief description of the following mines: Hale, Cincinnati, Biwabik, McKinley, Missabe Mountain, Security and Virginia. Notes on the re-examination of part of Morrison County.

711 **Winchell, N. H.** First annual report for the year 1872. M.G.S. for 1872. geol.map. 1873.
Abstract. Am.Jour.Sci. 3d ser.5:313. 1873.

Contents: Historical sketch and list of publications relating to the geology and natural history of Minnesota.—General principles.—Surface contour of the state.—Surface geology.—Sketch of the geology of Minnesota.

712 ———— The Fisher meteorite, chemical and mineral composition. Am.Geol. 20:316-17. N.1897.

713 ———— Fossils from the red quartzite at Pipestone. M.G.S.for 1884. 13:65-72. 1885.
Abstract. Am.Jour.Sci. 3d ser.30:396-97. 1885.
Abstract. Science. 6:220. 1885.

Describes two fossils which point to the fact that this formation is Primordial.

714 ———— General physical features of Minnesota. M.G.S. Final report. 1:111-41. 1884.

715 ———— Genesis of certain greensands of Minnesota. (Abstract) Science. n.s.33:462-65. Mr.24,1911.

716 ———— Geological atlas with synoptical descriptions. M.G.S.Final report v.6. 1901. 88 plates.

Reproductions of the earliest maps of Minnesota are given, from Franquelin's map of 1688 to and including Nicollet's map of 1842. All maps published in the preceding volumes of the Minnesota geological survey are also included.

717 ———— Geological notes from the early explorers in the Minnesota valley. Minn.Acad.Sci.Bull. 1:89-101, 153-56. 1874.

Reviews briefly the work of LeSueur, Carver, Keating, Featherstonhaugh, Nicollet, Shumard, and Hall.

718 ———— Geological report. M.G.S.for 1886. 15:211-399. map. 1887.

719 ———— Geology of Carlton County. M.G.S.Final report. 4:1-24, 550-65. illus.map. 1899.

"Describes the physiographic features and character and occurrence of the Archean and Cambrian rocks."

720 ———— Geology of Dakota County. M.G.S.Final report. 2:62-101. geol.map. 1888.

721 ———— Geology of Goodhue County. M.G.S.Final report. 2:20-61. geol.map. 1888.

722 ———— Geology of Hennepin County. In History of Minneapolis, by Isaac Atwater. pp.49-62. 1891.

723 ———— Geology of Hennepin County. M.G.S.Final report. 2:264-344. geol.map. 1888. also M.G.S.for 1876. 5:131-201. 1877.

724 **Winchell,** N.H. Geology of Houston County. M.G.S.Final report. 1:207-35. geol.map. 1884. also M.G.S.for 1876. 5:9-50. 1877.

"Describes the physiographic features and the character and occurrence of Archean rocks, Cambrian sediments and igneous intrusions, and glacial history of the region."

725 ———— Geology of Lake County. M.G.S.Final report. 4:266-312. illus.geol.map. 1899.

726 ———— Geology of Morrison County. M.G.S.for 1877. 6:50-53. geol.map. 1878.

727 ———— Geology of Ramsey County. M.G.S.Final report. 2:345-74. geol.map. 1888. also M.G.S.for 1877. 6:66-92. 1878.

728 ———— Geology of Rock and Pipestone counties. M.G.S.Final report. 1:533-61. geol.map. 1884. also M.G.S.for 1877. 6:93-111. map. 1878.

729 ———— Geology of the deep well drilled by C. C. Whelpley at Minneapolis at the "C" Washburn mill. M.G.S.for 1881. 10:211-17. 1882.

730 ———— Geology of the Duluth Plate. M.G.S.Final report. 4:566-80. geol.map. 1899.

731 ———— Geology of the Dunka River plate of the Mesabi iron Range. M.G.S.Final report. 4:390-98. geol.map. 1899.

732 ———— Geology of the Hibbing plate of the Mesabi iron Range. M.G.S.Final report. 4:358-64. geol.map. 1899.

733 ———— Geology of the iron ores of Minnesota. Geol. Soc.of Australia. Transactions. 1:171-81. 1892.

734 ———— Geology of the Minnesota Valley. In History of the Minnesota Valley, by E. D. Neill. pp.169-76. 1882.

735 ———— Geology of the Minnesota Valley. M.G.S.for 1873. 2:127-212. diagrs.map. 1874.

Reviews the accounts given by explorers.

736 ———— Geology of the Mississippi Valley at Little Falls. In Memoirs of exploration, by J. V. Brower. 5:89-104. 1902.

737 ———— Geology of the Mountain Iron plate of the Mesabi iron Range. M.G.S.Final report. 4:365-69. map. 1899.

738 ———— Geology of the northern part of St. Louis County. M.G.S.Final report. 4:222-65. illus.map. 1899.

739 ———— Geology of the Partridge River plate of the Mesabi iron Range. M.G.S.Final report. 4:383-89. map. 1899.

740 ———— Geology of the Pigeon Point plate. M.G.S. Final report. 4:502-21. illus.diagrs.map. 1899.

741 **Winchell,** N.H. Geology of the southern counties of Minnesota. M.G.S.Final report. 1:207-324,347-66,376-93,533-61, 648-73. illus.maps. 1884.

Includes Houston, Winona, Fillmore, Mower, Freeborn, Pipestone, Rock and Rice counties.

742 ———— Geology of the southern portion of St. Louis County. M.G.S.Final report. 4:212-21. illus.map. 1899.

The glacial deposits and Archean rocks are described.

743 ———— Geology of the Vermilion Lake plate. M.G.S. Final report. 4:522-49. illus.diagrs.map. 1899.

The physical geography of this region is described, with notes on the iron-bearing rocks.

744 ———— Geology of the Virginia plate of the Mesabi iron Range. M.G.S.Final report. 4:370-82. map. 1899.

745 ———— Geology of Wabasha County. M.G.S.Final report. 2:1-19. map. 1888.

746 ———— Geology of Washington County. M.G.S.Final report. 2:375-98. map. 1888.

747 ———— Glacial lakes of Minnesota. Geol.Soc.Am.Bull. 12:109-28. map. F.1901.

Brief description of a number of glacial lakes, some of which are practically peat bogs.

748 ———— Glacial lakes of St. Louis and Nemadji.(Abstract) Minn.Acad.Sci.Bull. 4:208. 1906.

749 ———— Great primordial quartzite. Am.Geol. 1:173-78. Mr.1888.

Discusses "a great primordial quartzite, which under different names extends from New England, through Canada into Wisconsin, Minnesota, and to the Black Hills of Dakota."

750 ———— Historical sketch of explorations and surveys in Minnesota. M.G.S.Final report. 1:1-110. 1884.

751 ———— and **Ulrich,** E. O. Historical sketch of investigations of the Lower Silurian in the upper Mississippi Valley. M.G.S.Final report. 3:1:pref.pp.9-53. 1895.

Gives chronological list of papers in which reference has been made to the Lower Silurian paleontology of the state.

752 **Winchell,** N. H. History of geological surveys in Minnesota. Minneapolis,1889. 37p. (M.G.S.Bulletin no.1).

753 ———— The Humboldt salt well in Kittson County. M.G.S.for 1884. 13:41-47. 1885.
Abstract. Am.Assoc.Adv.Sci. 33:399-400. 1885.

754 ———— The iron-bearing formation of northeastern Minnesota.(Abstract) Minn.Acad.Sci.Bull. 3:168-69. 1889.

755 ———— The iron-bearing rocks of Minnesota.(Abstract) Minn.Acad.Sci.Bull. 3:277-80. 1892.

A brief description of the formation in which iron ore occurs.

756 **Winchell,** N. H. Iron ore ranges of Minnesota and their differences. Minn.Acad.Sci.Bull. 5:43-68. illus.map. S.1911.

An address delivered at Aitkin, F.22,1911.

757 ———— and **Winchell,** H. V. The iron ores of Minnesota. illus.diagrs.maps. Minneapolis, 1891. 430p. (M.G.S. Bulletin no.6).

Abstract. Am.Geol. 7:370-74. Je.1891.
Abstract. E.andM.J. 52:3. Ja.1891.

Bibliography on the origin of iron ores, pp.263-334.

758 **Winchell,** N. H. The Kawishiwin agglomerate of Ely, Minn. Am.Geol. 9:359-68. Je.1892.

"Describes its peculiar characteristics at Ely, and considers it originated from the joint action of oceanic water and igneous action."

759 ———— The Keweenawan at Lake of the Woods in Minnesota.(Abstract) Science. n.s.23:289. F.23,1906.
Abstract. Am.Assoc.Adv.Sci. 55:378. 1906.

760 ———— List of rock samples, with annotations collected in 1896, 1897 and 1898. M.G.S.for 1895-98. 24:1-84. 1899.

761 ———— The loess of Minnesota. Am.Jour.Sci. 3d ser. 19:168-70. 1879.

762 ———— and **Schuchert,** Charles. The Lower Silurian Brachiopoda of Minnesota. M.G.S.Final report. 3:1:333-474. 1895.

763 **Winchell,** N. H. and **Ulrich,** E. O. The Lower Silurian deposits of the upper Mississippi. M.G.S.Final report. 3:2:pref.pp.83-129. 1897.

"A correlation of the strata with those in the Cincinnati, Tennessee, New York and Canadian Provinces, and the stratigraphic and geographic distribution of the fossils."

764 **Winchell,** N. H. Microscopic characters of the Fisher meteorite. Minnesota no.1. Am.Geol. 17:173-76,234-38. Mr.Ap.1896.

765 ———— Mineralogy and petrology of Minnesota. M.G.S. Final report. 5:937-99. 1900.

"Describes the character of the principal rock-forming minerals and the petrographic characters of the granites and gabbros, and discusses the evidences as to what are the oldest known rocks."

766 ———— Minnesota building stones. In U.S.Census office 10th census, 1880. 10:244-56. 1884.

767 ———— Natural gas in Minnesota. tables,maps. Minneapolis,1889. 59p. (M.G.S.Bulletin no.5)

768 ———— New iron-bearing horizon in the Keewatin in Minnesota. L.S.M.I. 5:46-48. 1898.

769 **Winchell,** N. H. The Norian of the Northwest. M.G.S. Bulletin 8:pref.pp.3-34. 1893.

"Gives an account of the investigation of the gabbros of the northern coast of Lake Superior, reviews the literature on the geology of this region, and describes the character and extent of gabbro rocks."

770 ———— Note on lignite in the Cretaceous of Minnesota. Am.Jour.Sci. 3d ser.10:307. 1875.

771 ———— Note on the age of the rocks of the Mesabi and Vermilion iron districts. M.G.S.for 1882. 11:168-70. 1884.

Gives the succession of rocks for northeastern Minnesota.

772 ———— Notes on a reconnaissance into Pope County, May 1884. M.G.S.for 1884. 13:10-19. geol.map. 1885.

773 ———— Notes of a trip across the Mesabi Range to Vermilion Lake. M.G.S.for 1884. 13:20-24. 1885.

Describes the rocks of the Mesabi Range seen along the Duluth and Iron Range Railway.

774 ———— Notes on some deep wells in Minnesota. M.G.S.for 1885. 14:11-16,348-53. 1886.

Record of wells in various places in Minnesota, and a discussion of the horizon of some of the beds passed through.

775 ———— Notes on the artesian wells at Mendota, Hastings, Red Wing, Lake City and Brownsville, and on the deep wells at St. Paul. M.G.S.for 1884. 13:55-64. 1885.

776 ———— Notes on the deep well drilled at East Minnepolis, in 1874-75. Minn.Acad.Sci.Bull. 1:187-89. 1875.
Abstract. Am.Jour.Sci. 3d ser.13:478. 1877.

777 ———— Notice on Lingula and Paradoxides from the red quartzytes of Minnesota. Am.Assoc.Adv.Sci. 34:214. 1886.
Abstract. Am.Jour.Sci. 30:316-17. 1885.

778 ———— Notice of the discovery of Lingula and Paradoxides in the red quartzite of Minnesota. Minn.Acad.Sci. Bull. 3:103-05. 1889.

"Description of the remains and brief references to the relations and age of the formation, and its representatives elsewhere."

779 ———— The oldest known rock.(Abstract) Am.Assoc. Adv.Sci. 47:302-03. 1898.
Abstract. Am.Geol. 22:262-63. O.1898.
Abstract. Science. n.s.8:504. O.14,1898.

"With a brief description of the other members of the Archean in Minnesota, the author more particularly describes the so-called greenstones of this state, which he considers the bottom of the Archean scale and the representative of the original crust of the earth, formed from the molten mass by the earliest consolidation"

780 **Winchell,** N. H. and **Winchell,** H .V. On a possible chemical origin of the iron ores of the Keewatin in Minnesota. Am. Geol. 4:291-300. N.1889.
Correspondence relating to this paper by C. R. Van Hise and the authors, ibid, 382-86.
Reprint. Am.Assoc.Adv.Sci. 38:235-42. 1890.
Reprint. M.G.S. Bulletin 6:391-99. 1891.

781 **Winchell,** N. H. Origin of the Archean igneous rocks. Am. Assoc.Adv.Sci. 47:303-304. 1898.
Abstract. Am.Geol. 22:299-310. N.1898.
Abstract. Science. n.s.8:504-05. O.14,1898.
Summary. Jour.Geol. 7:194. F.1899.

Discusses the transition from the clastic to igneous rocks.

782 ———— Oxide of manganese. M.G.S.for 1891. 20: 321-22. 1893.

"Contains brief note, with chemical analysis, of an occurrence of manganese found in Wright County, Minn."

783 ———— Peat. M.G.S.for 1873. 2:88-127. 1874.

Gives list of observed localities of peat deposits.

784 ———— and **Grant,** U. S. Petrographic geology of the crystalline rocks of Minnesota. M.G.S.Final report. 5:75-936. diagrs. 1900.

785 **Winchell,** N. H. The Potsdam sandstone. M.G.S.for 1881. 10:123-36. 1882.
Abstract. Am.Nat. 17:536. 1883.
Abstract. Am.Jour.Sci. 3d ser.25:153-56. 1883.

Gives summary of opinions as to what is the western representative of the Potsdam sandstone of New York.

786 ———— Preface. M.G.S. Final report. 4:pref.pp.13-20. 1899.

Outlines the nomenclature of the geologic formations used in the publications of the Minnesota geological survey.

787 ———— Preface. M.G.S.Final report. 2:pref.pp.13-24. 1888.

788 ———— and **Schuchert,** Charles. Preliminary descriptions of new Brachiopoda from the Trenton and Hudson River groups of Minnesota. Am.Geol. 9:284-94. My. 1892.
Abstract. Am.Geol. 12:332. N.1893.

789 **Winchell,** N. H. Preliminary list of rocks. M.G.S.for 1881. 10:9-122. 1882.
Abstract. Am.Jour.Sci. 3d ser.25:156. 1883.

790 ———— Preliminary list of rocks from the crystalline formations of northern Minnesota. M.G.S.for 1880. 9:10-114. 1881.

791 **Winchell,** N. H. and **Winchell,** H. V. Prof. Irving and the Keewatin series, and the origin and horizon of the iron ores of the Vermilion Lake series. Am.Geol. 4:383-86. D.1889.

"Review of Irving's writings in this connection, including references to the distribution, equivalency, and sideritic contents of iron-bearing series of Minnesota."

792 **Winchell,** N. H. Progress of opinion as to the origin of the Lake Superior ores. Geol.Soc.Am.Bull. 23:317-28. Jl. 15,1912.

Gives the conclusions of Foster, Whitney, Whittlesey, Irving and Spurr, and the results of his own study of the basic igneous rocks of Minnesota.

793 ——— Recession of the Falls of St. Anthony. Geol. Soc.Quar.Jour. 34:886-901. N.1878.

794 ——— Reconnaissances in Wright, Goodhue, Rice counties and along the Northern Pacific Railroad. M.G.S.for 1877. 6:43-49. 1878.

795 ——— Record of field observations in 1888-89. M.G.S. for 1889. 18:7-59. diagrs. 1890.
Abstract. Am.Geol. 7:198-99. 1891.
Abstract. Am.Nat. 25:737-38. 1891.

This report was written before the discovery of ore in the Mesabi district.

796 ——— Report of the salt spring lands due the state of Minnesota.

A history of all official transactions relating to them and a statement of their amount and location. Pub. by M.G.S. Minneapolis, 1874.

797 ——— Report of the section of mineralogy. Minn. Acad.Sci.Bull. 2:390-416. 1882.

Contents:—Bibliography of the mineralogy of Minnesota.—An enumeration of such minerals as are known to occur in the state.

798 ——— Report of the geology of Fillmore County. M.G.S.Final report. 1:268-324. map. 1884. also, M.G.S.for 1875. 4:13-74. 1876.

799 ——— Report of the geology of Freeborn County. M.G.S.Final report. 1:376-93. map. 1884. also, M.G.S.for 1874. 3:5-19. 1874.

800 ——— Report on the geology of Mower County. M.G. S.for 1874. 3:20-36. map. 1875.
Abstract. Am.Jour.Sci. 3d ser.10:306-07. 1875.

801 ——— Revision of the stratigraphy of the Cambrian in Minnesota. M.G.S.for 1885. 14:325-37. 1886.

Geologic studies in the valley of the Minnesota.

802 ——— Saponite, thalite, greenalite, greenstone. Geol. Soc.Am.Bull. 23:329-32. Jl.15,1912.

803 ——— Significance of the fragmental eruptive debris at Taylor's Falls, Minn. Am.Geol. 22:72-78. Ag.1898.

804 **Winchell,** N. H. Sketch of geological investigations in Minnesota. Jour.Geol. 2:692-707. O.1894.

An historical sketch of work in Minnesota since the discovery of the Falls of St. Anthony by Father Hennepin, in 1680.

805 ———— Sketch of the iron ores of Minnesota. Am.Geol. 29:154-62. Mr. 1902.
Reprint. Int.Min.Con.Proc. 4:136-40. 1902.

Paper read at Boise City, Idaho, before the 4th session of the International Mining Congress, on Jl.24,1901.

806 ———— Sketch of the work of the season of 1878. M.G.S.for 1878. 7:9-25. 1879.

The occurrence of iron ore near Gunflint Lake is noted.

807 ———— Some new features in the geology of northeastern Minnesota. Am.Geol. 20:41-51. Jl.1897.
Abstract. Minn.Acad.Sci.Bull. 4:201. 1906.

"Describes recent observations on the transition from crystalline schists to the Laurentian, the relations of the Stuntz conglomerate, and the nature and position of the coarse conglomerate in Puckwunge valley."

808 ———— Some problems of the Mesabi iron ore. Am. Geol. 10:169-79. S.1892.
Reprint. M.G.S.for 1892. 21:134-43. 1893.
Abstract. Am.Assoc.Adv.Sci. 41:176. 1893.

Paper read before section E of the American Association for the Advancement of Science, at Rochester, N. Y., Ag.22,1892.

809 ———— Some resemblances between the Archean of Minnesota and of Finland. Am.Geol. 21:222-29. Ap.1898.

810 ———— Some results of the late Minnesota geological survey. Am.Geol. 31:246-53. Ap.1903.

811 ———— Some thoughts on eruptive rocks, with special reference to those of Minnesota. Am.Assoc.Adv.Sci. 37:212-21. 1889.

In a general discussion of the origin of the eruptive rocks "maintains that there are four epochs of basic eruption in Minnesota."

812 ———— Source of the Mississippi. Am.Geol. 16:323-26. N.1895.
Reprint. Minn.Hist.Soc.Coll. 8:2:226-31. 1896.

813 ———— and **Schuchert,** Charles. Sponges, graptolites, and corals from the Lower Silurian of Minnesota. M.G.S. Final report. 3:1:55-95. 1895.
Abstract. Am.Geol. 12:331. N.1893.

814 **Winchell,** N. H. Structural geology. M.G.S.Final report. 5:1-74. 1900.

"Discusses the character, occurrence and origin of the Archean, Cambrian and igneous rocks of Minnesota."

815 ———— Structure of the Keweenawan, and additional petrographic descriptions. M.G.S.Final report. 5:1001-06. 1900.

816 **Winchell,** N.H. Structures of the Mesabi iron ore. L.S.M.I. 13:189-204. illus. 1908.

817 ———— Summary statement. M.G.S.for 1881. 10:5-8. 1881.
Review by J. D. Dana. Am.Jour.Sci. 3d ser.25:156-57. 1883.

Reviews the work of the year.

818 ———— and **Winchell,** H. V. Taconic iron ores of Minnesota and of western New England. Am.Geol. 6:263-74. N.1890.
Reprint. M.G.S. Bulletin 6:400-10. 1891.
Abstract. Am.Jour.Sci. 3d ser.40:332. 1890.

Read before the Geological Society of America, Indianapolis, Ag.22,1890. Describes five kinds of ore belonging to different geological horizons.

819 **Winchell,** N. H. Typical thin sections of the rocks of the cupriferous series in Minnesota. Am.Assoc.Adv.Sci. 30:160-66. 1881.
Reprint. M.G.S.for 1881. 10:137-43. 1882.

820 ———— Vegetable remains in the drift deposits of the Northwest. Am.Assoc.Adv.Sci. 24:2:43-56. 1876.

821 ———— Vermilion iron ores. M.G.S.for 1884. 13:25-31. 1885.

Brief description of the active mines.

822 ———— and **Grant,** U. S. Volcanic ash from the north shore of Lake Superior. Am.Geol. 18:211-13. O.1896.

"Describes the occurrence and megascopic characters of the rock from Keweenawan strata in Minnesota."

823 **Winchell,** N. H. Water supply of the Red River Valley. M.G.S.for 1877. 6:9-42. 1878.

824 **Wolff,** J. F. Mesabi Range mining. Wis.Eng. 13:227-45. illus. Je.1909.

The open pit, milling and underground systems of mining are described.

825 ———— Open-pit iron mining. M.andM. 29:291-93, 343-49. illus diagrs.tables,maps. F.-Mr.1909.

The system of exploration, methods of mining, equipment, development of cross sections, contour maps, methods of making tonnage estimates and determining the grades of tracks, are all discussed to illustrate the practice on the Mesabi Range.

825a ———— Ore bodies of the Mesabi Range. E. and M. J. 100:89-94,135-39,178-85,219-24. map.illus.diagr. Jl.17, 24,31,Ag.7,1915.

Contents: General geologic structure.—Actual ore bodies as developed.—Exploration and development.—Geologic formation.

826 **Woodbridge,** D. E. Beneficiating Lake iron ores. E.andM.J. 93:222-23. Ja.27,1912. also, E.andM.J. 95:311-12. F.8,1913.

Briefly considers concentration, calcining, the Grondal process, desulphurizing, and the Jones step process.

827 ———— Beneficiating Lake Superior ores. Ir.Age. 89: 163-64. Ja.11,1912.

Notes on concentration, magnetic separation, calcining, drying and briquetting.

828 ———— Changes and outlook in the Lake iron-ore trade. Ir.Age. 93:15-18. Ja.1,1914.

Contains notes on ore reserves, hydraulic stripping, Cuyuna manganiferous ores, and reviews the work of 1913.

829 ———— Close work in estimating. E.andM.J. 98:134. Jl.18,1914.

Table gives estimates made independently by four experts, on one property.

830 ———— Concentrating the lean ores of the Mesaba Range. Ir.Age. 85:48-52 illus. Ja.6,1910.

Describes the Coleraine plant of the Oliver Iron Mining Co., and the important developments at the Canisteo and other mines. Notes on a western Mesabi model mining town.

831 ———— Concentration of Mesaba ore. E.andM.J. 77: 960-61. illus. Je.14,1904.

832 ———— Eastern Minnesota ore dock. Ir.Age. 65:11-13. Je.21,1900.

833 ———— Electric power in Mesaba mining. Ir.Age. 75:2069-70. Je.29,1905.

Contains also notes on exploration on the "Deerwood Range."

834 ———— Handling material on the Mesaba. Ir.Age. 77:963. Mr.15,1906.
Abstract. U.S.G.S. Mineral resources. 1905:69-70. 1906.

Describes electrically driven shovels, size and capacity of steam shovels, and overhead machine for stripping and mining.

835 ———— Hill iron ore properties. Ir.Age. 77:26-28. Ja 4,1906.

"Explains the extent of the Hill holdings, their relation to the Steel Corporation, the advantageous position of the Hill interests and related matters of importance."

836 ———— Important Mesaba railroad extension. Ir.Age. 75:1905-06. Je.15,1905.

837 ———— Iron ore in Crow Wing County. E.andM.J. 84:775-76. O.26,1907.

Gives an account of recent discoveries of merchantable ore.

838 ———— Iron ore mining on the Mesaba Range. E.and M.J. 56:163. illus. Ag.12,1893.

Brief account of early methods on the Mesabi.

839 **Woodbridge,** D. E. Lake ore trade in 1903. Ir.Age. 73:100-01. Ja.7,1904.

840 ———— Lake Superior iron country. E.andM.J. 91: 31-32. Ja.7,1911.

Reviews developments of 1910.

841 ———— Lake Superior iron mining in 1907. Ir.Age. 81:140-42. tables. Ja.9,1908.

842 ———— Lake Superior iron ore district. E.andM.J. 95:85-86. Ja.11,1913. also, Ir.Age. 91:103-05. Ja.2, 1913.

Summary for the year 1912. Deals with the Great Northern lease, new explorations on the Cuyuna, and progress on the Mesabi and Vermilion Ranges.

843 ———— Lake Superior iron ore region. E. and M. J. 83:66-68. tables. Ja.5,1907.

Statistics for 1906, and mention of the "Hill deal."

844 ———— Lake Superior iron ore trade in 1901. Ir.Trd. Rev. 35:45. Ja.2,1902.

845 ———— Lake Superior iron ore trade in 1902. Ir.Age. 71:80-82. Ja.1,1903.

846 ———— Lake Superior iron ore trade in 1905. Ir.Age. 76:1756-58. D.29,1905.

847 ———— Lake Superior iron ranges. E.andM.J. 79:61-62. Ja.5,1905.

Review of progress for 1904.

848 ———— Lake Superior iron region. E.andM.J. 77:84-86. tables. Ja.14,1904.

849 ———— Lake Superior iron trade during 1900. M.andM. 21:318-19. F.1901; also Ir.Trd.Rev. 35:45. Ja.3, 1901.

Deals with the questions of ore reserves, ownership, and transportation.

850 ———— Lake Superior ore developments. Ir.Age. 89: 65-67. tables. Ja.4,1912.

Gives 1911 shipments by mines, and a list of plants for dressing ore.

851 ———— Lake Superior ore ranges. Ir.Age. 75:57-59. Ja.5,1905.

Reviews activities of the year 1904.

852 ———— The Lake Superior region. Mineral Industry. 21:455-57. 1912.

Gives statements concerning production, and a general summary of work accomplished in 1911.

853 ———— Low grade ores and their benefication. Min. Wld. 38:705-09. illus. Ap.12,1913.

Considers various methods of concentration in use in Minnesota, Alabama, and other deposits of low grade ore.

854 **Woodbridge,** D. E. Mesabi iron ore Range. Ir.Age. 69:60. Ja.2,1902.

Reviews the work of 1901.

855 ———— Mesabi iron ore Range. E.andM.J. 79:74-76; 122-24; 170-72; 266-68; 319-21; 365-67; 466-69; 557-60; 602-04; 698-700; 892-94. illus.diagrs.tables. Jl.-Dec.1905.

Contains notes on geology, ore deposits, mining methods and costs, and describes various mining plants.

856 ———— Mine accident prevention at Lake Superior iron mines. U.S Bureau of mines. Technical paper no.30. 1913.

857 ———— Mining with the steam shovel. M.andS.P. 92:417-18. illus. Je.23,1906.

858 ———— Notes from the Lake Superior iron ranges. E. andM.J. 89:863-64. Ap.23,1910.

859 ———— Notes on recent work on the Mesabi iron Range. E.andM.J. 76:201-02. Ag.8,1903.

Brief account of drill explorations.

860 ———— Recent discoveries and mines of Vermilion Range. Min.Wld. 34:827-30. illus. Ap 22,1911.

861 ———— Vermilion iron Range in Minnesota. E.andM.J. 75:261. F.14,1903.

862 ———— Western Mesaba iron ore explorations. Ir.Age. 74:34-35. Je.2,1904.

863 ———— Western Mesaba iron Range. Ir.Age. 77:420-21. map. F.1,1906.

Map shows holdings of the Oliver Iron Mining Co., and the Great Northern Railroad.

864 ———— Western Mesaba mining developments. Ir.Age. 75:430-32. My.4,1905.

865 ———— Winter stripping on the Mesaba. E.andM.J. 81:363. illus. F.24,1906.

866 **Woodward,** Anthony, and **Thomas,** B. W. The microscopical fauna of the Cretaceous in Minnesota, with additions from Nebraska and Illinois. M.G.S.Final report. 3:1:23-54. 1895.

"Describes the methods of microscopic preparation of the material and the foraminiferal and radiolarian remains found in the Cretaceous of Minnesota."

867 **Wright,** C. H. Modern methods of handling iron ore from Minnesota mines to Pittsburgh furnaces. Eng.News. 51:433-35. illus.diagrs. My.5,1904.

Y

868 **Youngs,** M. P. Northern iron fields. Min.Wld. 24:300-01. Mr.3,1906.

Information concerning the ores, traffic on Minnesota railroads, and the development work in progress.

Z

869 **Zapffe,** Carl. Cuyuna iron ore district of Minnesota. Unpublished thesis, University of Wisconsin, 1907. (Not seen)

870 ———— Cuyuna iron ore district of Minnesota. Supplement to the Brainerd, Minnesota, Tribune. pp.32-35. map. S.2,1910.

871 ———— Effects of a basic igneous intrusion on Lake Superior iron bearing formation. Econ.Geol. 7:145-78. illus. F.Mr.1912.

Attention is directed to the Gunflint district, located in northeastern Minnesota along the International boundary.

872 ———— Geology of Cuyuna iron ore district. Min.Wld. 34:585-88. map. Mr.18,1911.
Abstract. Science. n.s.33:463. Mr.24,1911.

Treats the geography and topography of this region, as well as the geology and ore deposits.

873 ———— and **Barrows,** W. A. The iron ores of the south range of the Cuyuna district, Minnesota. A.I.M.E. 44:3-13. illus. 1912.
Abstract. Ir.Trd.Rev. 51:881. N.7,1912.

"The information is from drill-hole records."

Anonymous

874 Active development under way on Hill lands. Ir.Trd.Rev. 52:1134. map. My.15,1913.

Taken from the report of the trustees. Map shows Great Northern holdings on the Mesabi Range.

875 Astonishing achievements on the Mesabi. Ir.Trd.Rev. 40: 831-32. illus.diagrs. My.23,1907.

876 Biwabik ore mine. Ir.Age. 66:4-6. illus. D.13,1900.

877 Breaking ground for steam shovels. E.andM.J. Handbook of mining details. p.37. 1912.

Describes the two systems of blasting the ground to be excavated by steam shovels in use in the Mesabi district.

878 Carnegie-Oliver ore interests. Ir.Age. 62:19. S.15,1898.

A review of the negotiations carried on by H. W. Oliver, which resulted in U. S. Steel Corporation control of vast mining properties on the Mesabi, Vermilion and Gogebic Ranges.

879 Carnegie-Oliver-Rockefeller agreement. Ir.Age. 59:22-23. F.18,1897.

879a Change house at the Bray mine, Mesabi Range. Min.Wld. 41:1087-88. illus.d agrs. D.12,1914.

880 Coleraine district, Mesabi Range. Min.Wld. 27:15-16. illus. Jl.6,1907.

881 Cuyuna iron ores. E.andM.J. 93:1284. Je.29,1912.

Brief article dealing with the grade of Cuyuna ores, the data gathered from the record of developed mines and more than 2500 drill holes.

882 Cuyuna iron Range. E.andM J. 93:1025. My.25,1912.

Brief discussion of ore in lenticular beds, cost of shaft sinking, excessive water, grade of ore and markets.

883 Cuyuna Range. E.andM.J. 90:1214. D.17,1910.

884 Cuyuna's first ore shipment. Min.Wld. 34:1187. Je.10, 1911.

885 Decline in iron content of Lake Superior ores during the past ten years (1902-1911). Ir.Trd.Rev. 51:863-64. tables. N.7,1912.

886 Description of the world's largest ore dock. Ir Trd.Rev. 50:191-96. illus.diagrs. Ja.18,1912.

The Great Northern ore docks at Allouez, Wisconsin, built to handle Mesabi ores, are described.

887 Detailed figures on iron ore shipments. Ir.Trd.Rev. 46:430-31. Mr.3,1910.

Statistics are given by mines.

888 Development in the Coleraine district. Ir.Trd.Rev. 40:997-1000. illus. Je.20,1907.

An account of the character and size of the ore deposits is given, with brief description of the Gilbert, Holman and Canisteo mines.

889 Difficult shaft sinking operation at Deerwood, Minnesota. Ir.Trd.Rev. 43:772-74. diagrs. N.5,1908.

Describes the sinking of a shaft at Rabbit Lake, and gives details of construction.

890 Disposal of waste. E.andM.J. Handbook of mining details, p.22. 1912.

Deals with the disposal of the overburden in stripping operations on the Mesabi.

891 Draining lakes on the Mesabi Range to mine iron ore. Min. Wld. 40:607. Mr.28,1914.

Describes the draining of Carson Lake, a state-owned property, worked under lease by the U. S. Steel Corporation.

892 Dredges to be used in stripping operations on the Mesabi. Min.Wld. 39:539. S.27,1913.

893 Drilling Mesabi gopher holes. E.andM.J. 96:1169-70. illus. D.20,1913.

894 Duluth and Iron Range railroad and ore docks. Min.Wld. 40:834. illus. My.2,1914.

895 Duluth, Minnesota. Special correspondence on the Minnesota iron ranges. M.and S.P. 108:190,469,667,1026. Ja.24, Mr.14,Ap.18,Je.20,1914.

Contains notes on state leases, beneficiation of lean ore, work of the Minnesota School of Mines, describes a revolving shovel to clean up ore, reviews the 1913 report of the U. S. Steel Corporation, and gives reports of progress from the Cuyuna Range.

896 Electric tramming at iron mines. Ir.Age. 85:1322-24. illus. Je.2,1910.

Describes the single-motor locomotive used in the Pioneer and Zenith mines at Ely, Minn.

897 Experience with steel ties under heavy ore traffic. Eng.Rec. 65:345. Mr.30,1912.

898 Fee owners file suit to regain Norman mine. Ir.Trd.Rev. 51:181. Jl.25,1912.

899 Grab system at the Grant mine, Buhl, Minn. Ir.Trd.Rev. 40:424-26. illus. Mr.14,1907.

This system is not offered as a substitute for the steam shovel.

900 Great Northern iron ore lands. Min Wld. 35:894. N.4,1911.

901 Great Northern iron ore shipments exceed those of other roads. Ir.Trd.Rev. 49:480. S.14,1911.

902 Great Northern ore lease will be cancelled. Ir Trd.Rev 49: 746,748-50,751. O.26,1911.

Announcement is made of freight reduction.

903 Handling ore from the Cuyuna Range. Ir.Trd.Rev. 53:729-33. illus. O.23 1913.

Describes the Northern Pacific ore dock at Allouez, Wisconsin.

904 Hill iron ore lands. E.andM.J. 82:693-94. O.13,1906.

Reviews the advantageous position of the Hill holdings, the transportation facilities, and related matters.

905 Hill ore holdings on the Mesabi Range. Ir.Trd.Rev. 36:39-40. F.19,1903.

Sketch of the Great Northern activities to 1903.

906 Hill ore lands in 1913. Ir.Age. 93:914. Ap.9,1914.

Abstract of the 1913 annual report.

907 Hoisting plant and steel shaft house for Oliver Iron Mining Co., at Ely. Eng.News. 50:449-53. illus.diagrs. N.19, 1903.

Detailed description of the Sibley and Savoy shafts.

908 Important Mesabi Range law suits. Min.Wld. 37:655-56. O.12,1912.

Ownership of ore underlying lake beds, and the annexation by the city of Virginia of an adjoining 1200-acre tract of land, are the the questions at issue.

909 Improved working conditions in iron mines. Min.Wld. 37: 232. Ap.10,1912.

910 Increase in iron contents of Lake Superior ores. Ir.Trd.Rev. 52:815-16. Ap.3,1913

Tables give analysis of ores by ranges.

910a Increased activity on the Cuyuna. Ir.Trd.Rev. 57:191. Jl.22,1915.

Gives details of developments during the first half of 1915.

911 Iron content of Lake ores. Ir.Age. 93:1096. Ap.30,1914.

Tables give average iron ore content of Bessemer and non-Bessemer ore by ranges for 1902, 1912, 1913.

912 Iron mines at Biwabik, Minn. Ir.Trd.Rev. v.39. illus. N.1,1906. 1800 words. (Not seen)

913 Iron mines of Minnesota in 1897. E.andM.J. 65:43. Ja.8, 1898.

914 Iron mining by steam shovel. E.andM.J. 64:759. D.25, 1897.

Describes the Vulcan steam shovel used at Virginia.

915 Iron mining on a big scale. M.and S.P. 92:383. Je.9,1906.

Reprinted from the Mining Gazette, Houghton, Michigan.

915a Iron ore assessments. Min.Wld. 42:67. Ja.2,1915.

916 Iron ore concentration in Minnesota. Met.and Chem.Eng. 10:717-19. illus.diagrs. N.1912.

Describes the methods used in the Trout Lake mill, Coleraine, and the Hawkins concentrating plant, Nashwauk.

917 Iron ore docks on the Lakes. Ir.Age. 89:1227. My.16,1912.

Gives owner, location, capacity and dimensions.

918 Iron-ore railroads at Lake Superior. E.andM.J. 93:1188. Je.15,1912.

919 Iron-ore shipments from Lake Superior ranges. Min.Wld. 36:171. Ja.27,1912.

Table gives shipments from all Lake Superior ranges from 1854 to 1911.

920 Iron ore shipping docks of the Great Lakes. Min.Wld. 38:95. Ja.18,1913.

Editorial dealing with changes in the size and equipment of ore docks made necessary by the growth in ore trade.

921 Iron region relief fund. Min.Wld. 34:308. F.4,1911.

922 Lake iron ore matters. Ir.Age. 58:725-26. O.15,1896.

Deals chiefly with the cost of mining in the Oliver mine.

922a Lake iron-ore railroad rates. E. and M. J. 99:832. My.8, 1915.

An editorial dealing with rates charged on iron ores from the Mesabi Range.

923 Lake iron ores in 1913. E.andM.J. 97:702. Ap.4,1914.

924 Lake Superior Institute meeting. E.andM.J. 96:455-56. S.6,1913.

Notes on a visit to the Minnesota Steel Plant at Duluth, the eastern Mesabi, the saw mill of the Virginia and Rainy Lake Co., Mountain Iron mine, Hull-Rust mine, and the inspection of the Western Mesabi.

925 Lake Superior Institute Minnesota meeting. Min.Wld. 39: 413-15. S. 6,1913.

926 Lake Superior iron ore shipments for 1913 and the past twenty years.

Annual table published by the Penton Publishing Co., Cleveland, and issued as a supplement to the Iron Trade Review.

926a Lake Superior iron ranges. E.andM.J. 99:73-76. Ja.9, 1915.

927 Lake Superior ore output. Engineering (London). 73:189-90. F.7,1902.

928 Large increase made in assessment of iron ore value by Tax commission. Ir.Trd.Rev. 51:887. N.7,1912.

Tables give summary of Minnesota Tax Commission's mineral assessment of iron ore in St. Louis, Itasca and Lake counties.

929 Large ore crusher at the Biwabik mine. Ir.Trd.Rev. 50:387-90. illus.diagrs. F.15,1912.

Describes an electrically driven iron ore crusher, which has a capacity of 1000 tons an hour.

930 Largest ore shipping dock in the world. Ir.Trd.Rev. 54:97-99. illus.diagrs. Ja.22,1914.

Details of the Duluth, Missabe and Northern Railway dock no. 5, at Duluth.

931 Lease of the Mountain Iron mine. Ir.Trd.Rev. 29:6-7. D.24,1896.

Editorial comment on this lease by the Carnegie Steel Co.

932 Legislation relative to Minnesota mines. Ir.Trd.Rev. 40:106. Ja.17,1907.

An editorial dealing with Governor Johnson's message concerning state owned iron properties, and a discussion of the taxation problems.

933 Living conditions on the Lake Superior ranges. Ir.Trd.Rev. 52:245-48. illus. Ja.23,1913.

934 Marvel of the Lake trade. Ir.Age. 78:677. S.13,1906.

Editorial on the changes in the size and capacity of the ore boats.

935 Marvelous development of the Mesaba Range. Ir.Age. 92:510-11. S.4,1913.

936 May tax mines. Minnesota town hits upon plan to increase revenue. Ir.Trd.Rev. 51:180. Jl.25,1912.

An account of the attempt to include mining properties in the city limits of Virginia.

937 Mesaba Range. Ir.Age. 56:216-19,277-80,386-89. illus. diagrs.tables,maps. Ag.1,8,22,1895.

Deals with ore reserves, analysis, commercial considerations, methods and cost of mining, ownership of the lands, and gives the original price paid for a number of the iron ore properties.

938 Mesabi underground turn timbering. E.andM.J. 97:1195. illus. Je.13,1914.

939 Milling system of mining Mesabi iron. E.andM.J. 96:545-46. S.20,1913.

Brief description of the working of this system at various mines.

940 Minnesota has large income from iron lands. Min.Wld. 38: 426. Mr.1,1913.

940a Minnesota iron-ore tax. Ir.Age. 94:1235. N.26,1914.

941 Minnesota school of mines. Min.Wld. 35:492. S.9,1911.

Brief note of a trip made over the Mesabi Range, Ag.11-12,1911.

942 Minnesota state lands. E.andM.J. 78:194. Ag.4,1904.

Brief statement under date of Jl.29, from Duluth of the system of leasing and the location of state properties.

943 Minnesota Steel Co.'s new plant at Duluth. Ir.Trd.Rev. 48:543-44. illus.diagrs. Mr.16,1911; also Ir.Trd.Rev. 50:349-52. F.8,1912.

Gives some features of construction, with the general arrangement of the roll stands in the rail and merchant mills.

944 Minnesota Steel Company's plant. Ir.Age. 92:603-05. illus. S.18,1913.

Description of this steel-plant, near Duluth, explaining the engineering and economic problems.

945 Minnesota's iron ore revenue. Min.Wld. 32:47. Ja.8,1910.

946 Minnesota's ore-carrying railroads. Min.Wld. 32:90. Ja. 15,1910.

947 Minnesota's revenues from iron lands. Min.Wld. 40:404. F.28,1914.

948 Minnesota's state iron lands in 1913. E.andM.J. 97:82. Ja.10,1914.

Gives a list of state owned mines, their tonnage, operators and terms of the lease.

949 Moving towns to make way for Lake Superior mines. Min.Wld. 37:184. Ag.3,1912.

Discusses the necessity for moving Hibbing, on the Mesabi Range.

950 New developments in the Lake iron ore district. Ir.Trd.Rev. 51:111-18. illus. Jl.18,1912.

Summary of events on the Minnesota and Michigan ranges since the beginning of the year.

951 New Duluth plant of the Minnesota Steel Co. Min.Wld. 39: 508. S.20,1913.

952 New ore dock at Two Harbors. Ir.Trd.Rev. 49:1143-46. illus.diagrs. D.28,1911.

Describes the Duluth and Iron Range dock No. 1.

953 New record for Mesabi. Ir.Trd.Rev. 53:568. S.25,1913.

Careful estimate compiled by W. W. Croze of Duluth on the expected output of each mine.

954 New steam shovel for cleaning up on the Mesabi Range. E.and M.J. 96:1159-60. illus. D.20,1913.

955 New steel plant at Duluth. Ir.Age. 88:1196-98. diagrs. N.30,1911.

Describes the exceptional facilities for transportation through belt line connections.

956 No charge for storage and loading at iron ore docks. Min.Wld. 38:342. F.15,1913.

Reviews factors which determine a reasonable charge for transporting and handling ores. A Michigan and Minnesota problem.

957 Notable Minnesota underground mine. Features of the Leonidas property of the Oliver Iron Mining Co. Ir.Trd.Rev. 54:320-22. illus. F.12,1914.

958 Oliver Iron Mining Co.'s shops at Hibbing. Ir.Trd.Rev. 51:65-71. illus.diagrs. Jl.11,1912.

Gives the layout of headquarters, the arrangement of tools, safety devices, and the investigations of accidents.

959 Open cut mining on the Missabe Range. E.andM.J. 74:302-03. S.6,1902.

960 Ore at depth on the Mesabi. E.andM.J. 96:1116. D.13, 1913.

Gives record of a well hole recently put down in Virginia, that may lead to the discovery of new features of the geologic formation.

961 Ownership of iron-ore deposits. Min.Wld. 35:1307. D.30, 1911.

An editorial dealing with the ownership of land under lakes and rivers.

962 Plant of the Minnesota Steel Co. at Duluth. Ir.Trd.Rev. 53:867-75. illus.diagrs. N.13,1913.

Gives general arrangement of these works, which will handle two blast furnaces, open-hearth department, blooming, rail, and merchant mills.

963 Plants for washing lean iron ores. Eng.News. 68:449. S.5, 1912.

Describes the washing plants at Coleraine and at Nashwauk.

963a Present operations of Great Northern iron ore properties. E. and M. J. 99:540-41. Mr.20,1915.

Brief notes on the Mesabi Range mines now operated by this company.

964 Problem of mining sandy ores at Coleraine. Ir.Trd.Rev. v. 39. D.6,1906. 3000 words. (Not seen.)

Illustrates account of two mining towns being built by the Steel Corporation, some unusual mining conditions, methods of washing ore, and related subjects, dealing with the western Mesabi.

965 Progress on Minnesota Steel Co.'s plant. E.andM.J. 96:601. S.27,1913.

The location, capacity and housing problems are explained.

966 Public schools on the Mesabi Range. E.andM.J. 90:1052. N.6,1910.

Notes on the school system of Hibbing, the various nationalities attending school and some of the difficulties encountered.

967 Quietus on speculators is placed by Minnesota Tax commission, which develops the facts about iron ore deposits of the Cuyuna Range. Ir.Trd.Rev. 55:985. N.26,1914.

968 Raise valuation of Minnesota mining property by Tax Commission. Ir.Trd.Rev. 49:680. O.19,1911.

969 Record breaking year of iron ore shipments. Ir.Trd.Rev. 48:432-33. Mr.2,1911.

Table shows shipments by mines.

970 Replacing a timber ore dock with a concrete and steel structure. Eng.Rec. 65:496. My.4,1912.

The Duluth and Iron Range Railroad dock no. 1 at Two Harbors is described.

971 Rock drilling in Lake Superior iron mines. M.andS.P. 108:494. Mr.21,1914.

Describes the rock drills in use.

972 The Rockefeller ore interests. Ir.Age. 63:12. My.11,1899.

An account of the mines, the railroads and fleet of steel ships on the Great Lakes, acquired by the Rockefeller interests, and gives a list of mines leased to mining companies.

973 Safety devices lessen death rate on Mesabi Range. Min.Wld. 37:760. O.26,1912.

Abstract of the report of the Mine Inspector of St. Louis Co.

974 Sensationalism and mine accidents. Min.Wld. 35:187-88. Jl.29,1911.

An editorial criticizing an article written by a member of the Minnesota Bureau of Labor.

975 Shaft sinking on the Mesabi. M.andS.P. 108:464. Mr.14, 1914.

Describes types of concrete shafts sunk by the Oliver Iron Mining Co.

976 Shipment from Mesaba and Vermilion iron mines in 1909. Ir.Age. 85:227. Ja.27,1910.

977 Sinking a concrete shaft lining through quicksand. Eng.Rec. 67:383-84. diagrs. Ap.5,1913.
Reprint. E.andM.J. 95:194-95. Je.14,1913

Describes a shaft sinking operation carried on by a combination of the open-dredging and pneumatic-caisson processes at the Adams mine near Deerwood, Minn.

978 Sinking a shaft through quicksand by the pneumatic process. Eng.Rec. 56:46-47. Jl.13,1907.

979 Splendid progress made in reducing accidents in Michigan and Minnesota. Ir.Trd.Rev. 53:1167. D.25,1913

980 State mines profitable. Ir.Trd.Rev. 52:423. F.13,1913.

Gives a list of mines owned by the state, with their shipments in gross tons.

981 Steam shovels for ore mining. Min.Wld. 32:652. Mr.26, 1910.

982 Steel corporation's Vermilion mines. Ir.Age. 78:676. S.13, 1906.

Briefly describes a number of the producing mines.

983 Stripping operations on the Mesabi Range. Min.Wld. 32:429. F.19,1910.

983a Stripping the Pennington mine. Excavating Engineer. 11:175-76. illus. F.1915.

984 Stripping with dredges. Ir.Trd.Rev. 53:568. S.25,1913.

985 The truth about the Cuyuna. Ir.Trd.Rev. 22:972. N.26, 1914.

Editorial dealing with the work of the Minnesota Tax Commission.

986 Two-blast-furnace plant at West Duluth. Eng.Rec. 70:102-05. illus.diagrs. Jl.25,1914.

"Describes latest designs in buildings, arrangement and equipment."

987 Types of headframes on Michigan and Minnesota Ranges. E.andM.J. 97:1063. My.23,1914.

A group of illustrations which show nine types of headframes.

988 Ups and downs of Lake Superior ore prices. Ir.Trd.Rev. 51:1026-28. diagrs.tables. N.28,1912.

Statistics cover years 1889-1912.

989 Valuation of Lake iron mines. Min.Wld. 35:786. O.21,1911.

Editorial discussing the proposed increase in tax assessments in Minnesota.

990 Wages paid on the Mesabi Range. E.andM.J. 90:1244. D.24,1910.

991 Wonderful iron mines of Lake Superior. Sci.Am. 101:430-32. illus. D.11,1909.

Detailed descriptions of the unloading and handling machinery at the docks, a discussion of the transportation problems, and a brief note on mining methods.

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